

digital

OpenVMS RTL Library (LIB\$)  
Manual

OpenVMS

# OpenVMS



---

# OpenVMS RTL Library (LIB\$) Manual

Order Number: AA-QSBHA-TE

**December 1995**

This manual documents the library routines contained in the LIB\$ and CVT\$ facilities of the OpenVMS Run-Time Library.

**Revision/Update Information:** This manual supersedes the *OpenVMS RTL Library (LIB\$) Manual*, OpenVMS AXP Version 6.1 and OpenVMS VAX Version 6.1.

**Software Version:** OpenVMS Alpha Version 7.0  
OpenVMS VAX Version 7.0

**Digital Equipment Corporation  
Maynard, Massachusetts**

---

**December 1995**

Digital Equipment Corporation makes no representations that the use of its products in the manner described in this publication will not infringe on existing or future patent rights, nor do the descriptions contained in this publication imply the granting of licenses to make, use, or sell equipment or software in accordance with the description.

Possession, use, or copying of the software described in this publication is authorized only pursuant to a valid written license from Digital or an authorized sublicensor.

Digital conducts its business in a manner that conserves the environment and protects the safety and health of its employees, customers, and the community.

© Digital Equipment Corporation 1995. All rights reserved.

The following are trademarks of Digital Equipment Corporation: Alpha, Bookreader, DEC, DEC C, DECmigrate, DECnet, DECwindows, Digital, OpenVMS, PDP-11, VAX, VAX Ada, VAX BASIC, VAX MACRO, VMS, and the DIGITAL logo.

The following are third-party trademarks.

BASIC is a registered trademark of the Trustees of Dartmouth College.

CRAY is a registered trademark of Cray Research, Inc.

IBM is a registered trademark of International Business Machines Corporation.

IEEE is a registered trademark of the Institute of Electrical and Electronics Engineers, Inc.

Internet is a registered trademark of Internet, Inc.

Motif is a registered trademark of the Open Software Foundation, Inc.

All other trademarks and registered trademarks are the property of their respective holders.

ZK5932

This document is available on CD-ROM.

---

# Contents

|               |    |
|---------------|----|
| Preface ..... | ix |
|---------------|----|

## 1 Overview of the LIB\$ Facility

|       |   |     |
|-------|---|-----|
| 1.1   | Run-Time Library LIB\$ Routines .....                   | 1-1 |
| 1.1.1 | 64-Bit Addressing Support .....                         | 1-1 |
| 1.1.2 | The LIB\$ Routines .....                                | 1-2 |
| 1.2   | Translated Version of LIB\$ Facility (Alpha Only) ..... | 1-8 |
| 1.3   | Run-Time Library CVT\$ Facility .....                   | 1-8 |

## LIB\$ Reference Section

|  |        |
|--|--------|
| LIB\$ADAWI .....                               | LIB-3  |
| LIB\$ADDX .....                                | LIB-5  |
| LIB\$ADD_TIMES .....                           | LIB-8  |
| LIB\$ANALYZE_SDESC .....                       | LIB-10 |
| LIB\$ANALYZE_SDESC_64 (Alpha Only) .....       | LIB-12 |
| LIB\$ASN_WTH_MBX .....                         | LIB-14 |
| LIB\$AST_IN_PROG .....                         | LIB-17 |
| LIB\$ATTACH .....                              | LIB-19 |
| LIB\$BBCCI .....                               | LIB-21 |
| LIB\$BBSI .....                                | LIB-23 |
| LIB\$BUILD_NODESPEC .....                      | LIB-25 |
| LIB\$CALLG .....                               | LIB-28 |
| LIB\$CALLG_64 (Alpha Only) .....               | LIB-30 |
| LIB\$CHAR .....                                | LIB-31 |
| LIB\$COMPARE_NODENAME .....                    | LIB-33 |
| LIB\$COMPRESS_NODENAME .....                   | LIB-35 |
| LIB\$CONVERT_DATE_STRING .....                 | LIB-38 |
| LIB\$CRC .....                                 | LIB-42 |
| LIB\$CRC_TABLE .....                           | LIB-44 |
| LIB\$CREATE_DIR .....                          | LIB-46 |
| LIB\$CREATE_USER_VM_ZONE .....                 | LIB-50 |
| LIB\$CREATE_USER_VM_ZONE_64 (Alpha Only) ..... | LIB-54 |
| LIB\$CREATE_VM_ZONE .....                      | LIB-57 |
| LIB\$CREATE_VM_ZONE_64 (Alpha Only) .....      | LIB-63 |
| LIB\$CRF_INS_KEY .....                         | LIB-69 |
| LIB\$CRF_INS_REF .....                         | LIB-71 |
| LIB\$CRF_OUTPUT .....                          | LIB-74 |
| LIB\$CURRENCY .....                            | LIB-78 |

|   |         |
|---|---------|
| LIB\$CVTF_FROM_INTERNAL_TIME .....        | LIB-80  |
| LIB\$CVTF_TO_INTERNAL_TIME .....          | LIB-82  |
| LIB\$CVT_DX_DX .....                      | LIB-84  |
| LIB\$CVT_FROM_INTERNAL_TIME .....         | LIB-90  |
| LIB\$CVT_TO_INTERNAL_TIME .....           | LIB-93  |
| LIB\$CVT_VECTIM .....                     | LIB-95  |
| LIB\$CVT_xTB .....                        | LIB-97  |
| LIB\$CVT_xTB_64 (Alpha Only) .....        | LIB-99  |
| LIB\$DATE_TIME .....                      | LIB-101 |
| LIB\$DAY .....                            | LIB-103 |
| LIB\$DAY_OF_WEEK .....                    | LIB-105 |
| LIB\$DECODE_FAULT .....                   | LIB-107 |
| LIB\$DEC_OVER .....                       | LIB-126 |
| LIB\$DELETE_FILE .....                    | LIB-128 |
| LIB\$DELETE_LOGICAL .....                 | LIB-136 |
| LIB\$DELETE_SYMBOL .....                  | LIB-138 |
| LIB\$DELETE_VM_ZONE .....                 | LIB-140 |
| LIB\$DELETE_VM_ZONE_64 (Alpha Only) ..... | LIB-142 |
| LIB\$DIGIT_SEP .....                      | LIB-144 |
| LIB\$DISABLE_CTRL .....                   | LIB-146 |
| LIB\$DO_COMMAND .....                     | LIB-148 |
| LIB\$EDIV .....                           | LIB-150 |
| LIB\$EMODD .....                          | LIB-152 |
| LIB\$EMODF .....                          | LIB-154 |
| LIB\$EMODG .....                          | LIB-156 |
| LIB\$EMODH .....                          | LIB-158 |
| LIB\$EMUL .....                           | LIB-160 |
| LIB\$ENABLE_CTRL .....                    | LIB-162 |
| LIB\$ESTABLISH .....                      | LIB-164 |
| LIB\$EXPAND_NODENAME .....                | LIB-167 |
| LIB\$EXTV .....                           | LIB-170 |
| LIB\$EXTZV .....                          | LIB-173 |
| LIB\$FFx .....                            | LIB-175 |
| LIB\$FID_TO_NAME .....                    | LIB-177 |
| LIB\$FILE_SCAN .....                      | LIB-180 |
| LIB\$FILE_SCAN_END .....                  | LIB-182 |
| LIB\$FIND_FILE .....                      | LIB-184 |
| LIB\$FIND_FILE_END .....                  | LIB-188 |
| LIB\$FIND_IMAGE_SYMBOL .....              | LIB-189 |
| LIB\$FIND_VM_ZONE .....                   | LIB-192 |
| LIB\$FIND_VM_ZONE_64 (Alpha Only) .....   | LIB-194 |
| LIB\$FIT_NODENAME .....                   | LIB-196 |
| LIB\$FIXUP_FLT .....                      | LIB-199 |
| LIB\$FLT_UNDER .....                      | LIB-201 |
| LIB\$FORMAT_DATE_TIME .....               | LIB-203 |
| LIB\$FORMAT_SOGW_PROT (VAX Only) .....    | LIB-206 |
| LIB\$FREE_DATE_TIME_CONTEXT .....         | LIB-209 |

|   |         |
|---|---------|
| LIB\$FREE_EF                            | LIB-210 |
| LIB\$FREE_LUN                           | LIB-211 |
| LIB\$FREE_TIMER                         | LIB-212 |
| LIB\$FREE_VM                            | LIB-213 |
| LIB\$FREE_VM_64 (Alpha Only)            | LIB-216 |
| LIB\$FREE_VM_PAGE                       | LIB-219 |
| LIB\$FREE_VM_PAGE_64 (Alpha Only)       | LIB-221 |
| LIB\$GETDVI                             | LIB-223 |
| LIB\$GETJPI                             | LIB-228 |
| LIB\$GETQUI                             | LIB-233 |
| LIB\$GETSYI                             | LIB-238 |
| LIB\$GET_ACCNAM (VAX Only)              | LIB-242 |
| LIB\$GET_ACCNAM_BY_CONTEXT (VAX Only)   | LIB-244 |
| LIB\$GET_COMMAND                        | LIB-246 |
| LIB\$GET_COMMON                         | LIB-249 |
| LIB\$GET_CURR_INVO_CONTEXT (Alpha Only) | LIB-251 |
| LIB\$GET_DATE_FORMAT                    | LIB-252 |
| LIB\$GET_EF                             | LIB-254 |
| LIB\$GET_FOREIGN                        | LIB-256 |
| LIB\$GET_FULLNAME_OFFSET                | LIB-260 |
| LIB\$GET_HOSTNAME                       | LIB-262 |
| LIB\$GET_INPUT                          | LIB-265 |
| LIB\$GET_INVO_CONTEXT (Alpha Only)      | LIB-268 |
| LIB\$GET_INVO_HANDLE (Alpha Only)       | LIB-270 |
| LIB\$GET_LUN                            | LIB-271 |
| LIB\$GET_MAXIMUM_DATE_LENGTH            | LIB-273 |
| LIB\$GET_PREV_INVO_CONTEXT (Alpha Only) | LIB-275 |
| LIB\$GET_PREV_INVO_HANDLE (Alpha Only)  | LIB-276 |
| LIB\$GET_SYMBOL                         | LIB-277 |
| LIB\$GET_USERS_LANGUAGE                 | LIB-280 |
| LIB\$GET_VM                             | LIB-281 |
| LIB\$GET_VM_64 (Alpha Only)             | LIB-283 |
| LIB\$GET_VM_PAGE                        | LIB-285 |
| LIB\$GET_VM_PAGE_64 (Alpha Only)        | LIB-287 |
| LIB\$ICHAR                              | LIB-289 |
| LIB\$INDEX                              | LIB-291 |
| LIB\$INIT_DATE_TIME_CONTEXT             | LIB-293 |
| LIB\$INIT_TIMER                         | LIB-297 |
| LIB\$INSERT_TREE                        | LIB-299 |
| LIB\$INSERT_TREE_64 (Alpha Only)        | LIB-308 |
| LIB\$INSQHI                             | LIB-317 |
| LIB\$INSQHIQ (Alpha Only)               | LIB-320 |
| LIB\$INSQTI                             | LIB-323 |
| LIB\$INSQTIQ (Alpha Only)               | LIB-326 |
| LIB\$INSV                               | LIB-329 |
| LIB\$INT_OVER                           | LIB-331 |
| LIB\$LEN                                | LIB-333 |

|  |         |
|--|---------|
| LIB\$LOCC .....                            | LIB-334 |
| LIB\$LOOKUP_KEY .....                      | LIB-337 |
| LIB\$LOOKUP_TREE .....                     | LIB-341 |
| LIB\$LOOKUP_TREE_64 (Alpha Only) .....     | LIB-343 |
| LIB\$LP_LINES .....                        | LIB-345 |
| LIB\$MATCHC .....                          | LIB-347 |
| LIB\$MATCH_COND .....                      | LIB-349 |
| LIB\$MOVC3 .....                           | LIB-352 |
| LIB\$MOVC5 .....                           | LIB-354 |
| LIB\$MOVTC .....                           | LIB-356 |
| LIB\$MOVTUC .....                          | LIB-373 |
| LIB\$MULTF_DELTA_TIME .....                | LIB-376 |
| LIB\$MULT_DELTA_TIME .....                 | LIB-377 |
| LIB\$PARSE_ACCESS_CODE (VAX Only) .....    | LIB-378 |
| LIB\$PARSE_SOGW_PROT (VAX Only) .....      | LIB-381 |
| LIB\$PAUSE .....                           | LIB-384 |
| LIB\$POLYD .....                           | LIB-385 |
| LIB\$POLYF .....                           | LIB-387 |
| LIB\$POLYG .....                           | LIB-390 |
| LIB\$POLYH .....                           | LIB-392 |
| LIB\$PUT_COMMON .....                      | LIB-394 |
| LIB\$PUT_INVO_REGISTERS (Alpha Only) ..... | LIB-396 |
| LIB\$PUT_OUTPUT .....                      | LIB-398 |
| LIB\$RADIX_POINT .....                     | LIB-400 |
| LIB\$REMQHI .....                          | LIB-402 |
| LIB\$REMQHIQ (Alpha Only) .....            | LIB-405 |
| LIB\$REMQTI .....                          | LIB-408 |
| LIB\$REMQTIQ (Alpha Only) .....            | LIB-411 |
| LIB\$RENAME_FILE .....                     | LIB-414 |
| LIB\$RESERVE_EF .....                      | LIB-423 |
| LIB\$RESET_VM_ZONE .....                   | LIB-425 |
| LIB\$RESET_VM_ZONE_64 (Alpha Only) .....   | LIB-427 |
| LIB\$REVERT .....                          | LIB-429 |
| LIB\$RUN_PROGRAM .....                     | LIB-430 |
| LIB\$SCANC .....                           | LIB-432 |
| LIB\$SCOPY_DXDX .....                      | LIB-434 |
| LIB\$SCOPY_R_DX .....                      | LIB-436 |
| LIB\$SCOPY_R_DX_64 (Alpha Only) .....      | LIB-438 |
| LIB\$SET_LOGICAL .....                     | LIB-440 |
| LIB\$SET_SYMBOL .....                      | LIB-444 |
| LIB\$SFREE1_DD .....                       | LIB-447 |
| LIB\$SFREEN_DD .....                       | LIB-448 |
| LIB\$SGET1_DD .....                        | LIB-450 |
| LIB\$SGET1_DD_64 (Alpha Only) .....        | LIB-452 |
| LIB\$SHOW_TIMER .....                      | LIB-454 |
| LIB\$SHOW_VM .....                         | LIB-458 |
| LIB\$SHOW_VM_64 (Alpha Only) .....         | LIB-461 |

|   |         |
|---|---------|
| LIB\$SHOW_VM_ZONE .....                   | LIB-464 |
| LIB\$SHOW_VM_ZONE_64 (Alpha Only) .....   | LIB-470 |
| LIB\$SIGNAL .....                         | LIB-476 |
| LIB\$SIG_TO_RET .....                     | LIB-480 |
| LIB\$SIG_TO_STOP .....                    | LIB-482 |
| LIB\$SIM_TRAP .....                       | LIB-484 |
| LIB\$SKPC .....                           | LIB-486 |
| LIB\$SPANC .....                          | LIB-488 |
| LIB\$SPAWN .....                          | LIB-492 |
| LIB\$STAT_TIMER .....                     | LIB-498 |
| LIB\$STAT_VM .....                        | LIB-502 |
| LIB\$STAT_VM_64 (Alpha Only) .....        | LIB-504 |
| LIB\$STOP .....                           | LIB-506 |
| LIB\$SUBX .....                           | LIB-508 |
| LIB\$SUB_TIMES .....                      | LIB-510 |
| LIB\$SYS_ASC_TIM .....                    | LIB-512 |
| LIB\$SYS_FAO .....                        | LIB-514 |
| LIB\$SYS_FAOL .....                       | LIB-516 |
| LIB\$SYS_FAOL_64 (Alpha Only) .....       | LIB-518 |
| LIB\$SYS_GETMSG .....                     | LIB-520 |
| LIB\$TPARSE/LIB\$TABLE_PARSE .....        | LIB-523 |
| LIB\$TRAVERSE_TREE .....                  | LIB-584 |
| LIB\$TRAVERSE_TREE_64 (Alpha Only) .....  | LIB-586 |
| LIB\$TRA_ASC_EBC .....                    | LIB-588 |
| LIB\$TRA_EBC_ASC .....                    | LIB-592 |
| LIB\$TRIM_FILESPEC .....                  | LIB-595 |
| LIB\$TRIM_FULLNAME .....                  | LIB-598 |
| LIB\$VERIFY_VM_ZONE .....                 | LIB-601 |
| LIB\$VERIFY_VM_ZONE_64 (Alpha Only) ..... | LIB-602 |
| LIB\$WAIT .....                           | LIB-603 |

### CVT\$ Reference Section

|                          |       |
|--------------------------|-------|
| CVT\$CONVERT_FLOAT ..... | CVT-3 |
| CVT\$FTOF .....          | CVT-9 |

### Index

### Figures

|       |  |         |
|-------|--|---------|
| LIB-1 | Structure of a Protection Mask .....                                     | LIB-47  |
| LIB-2 | Summary of Symbol Names and Values .....                                 | LIB-76  |
| LIB-3 | Summary of Symbol Names, Values, and Names of Referring<br>Modules ..... | LIB-76  |
| LIB-4 | Summary Indicating Defining Modules .....                                | LIB-77  |
| LIB-5 | Keyword Table .....  | LIB-338 |
| LIB-6 | LIB\$AB_ASC_EBC .....  | LIB-358 |

|        |   |         |
|--------|---|---------|
| LIB-7  | LIB\$AB_ASC_EBC_REV .....                                   | LIB-359 |
| LIB-8  | LIB\$AB_EBC_ASC .....                                       | LIB-360 |
| LIB-9  | LIB\$AB_EBC_ASC_REV .....                                   | LIB-361 |
| LIB-10 | LIB\$AB_CVTPT_O .....                                       | LIB-362 |
| LIB-11 | LIB\$AB_CVTPT_U .....                                       | LIB-363 |
| LIB-12 | LIB\$AB_CVTTP_O .....                                       | LIB-364 |
| LIB-13 | LIB\$AB_CVTTP_U .....                                       | LIB-365 |
| LIB-14 | LIB\$AB_CVT_O_U .....                                       | LIB-366 |
| LIB-15 | LIB\$AB_CVT_U_O .....                                       | LIB-367 |
| LIB-16 | LIB\$AB_CVTPT_Z .....                                       | LIB-368 |
| LIB-17 | LIB\$AB_CVTTP_Z .....                                       | LIB-369 |
| LIB-18 | LIB\$AB_UPCASE .....  | LIB-370 |
| LIB-19 | LIB\$AB_LOWERCASE .....                                     | LIB-371 |
| LIB-20 | LIB\$T[ABLE_]PARSE 32-bit Argument Block .....              | LIB-538 |
| LIB-21 | LIB\$T[ABLE_]PARSE 64-Bit Argument Block (Alpha Only) ..... | LIB-539 |
| LIB-22 | Transition Diagram for a Hypothetical Utility .....         | LIB-544 |
| LIB-23 | Tabular Diagram of a Hypothetical Utility .....             | LIB-545 |
| LIB-24 | LIB\$AB_ASC_EBC .....                                       | LIB-589 |
| LIB-25 | LIB\$AB_EBC_ASC .....                                       | LIB-593 |

## Tables

|        |   |         |
|--------|---|---------|
| 1-1    | LIB\$ Routines .....  | 1-2     |
| 1-2    | Translated LIB\$ Routines (Alpha Only) .....  | 1-8     |
| LIB-1  | OpenVMS Descriptor Class and Data Type Combinations Accepted by LIB\$CVT_DX_DX .....          | LIB-86  |
| LIB-2  | LIB\$CVT_DX_DX Destination NBDS Formats .....   | LIB-88  |
| LIB-3  | Symbols for Fields and Values for Operand Access and Data Types Using LIB\$DECODE_FAULT ..... | LIB-112 |
| LIB-4  | Formats Used for LIB\$GETDVI Strings .....  | LIB-226 |
| LIB-5  | Item Code Formats for LIB\$GETJPI .....   | LIB-230 |
| LIB-6  | Item Code Formats for LIB\$GETQUI .....   | LIB-236 |
| LIB-7  | LIB\$SHOW_VM_ZONE Error and Warning Messages .....  | LIB-466 |
| LIB-8  | LIB\$SHOW_VM_ZONE_64 Error and Warning Messages .....   | LIB-472 |
| LIB-9  | The Alphabet of LIB\$T[ABLE_]PARSE .....  | LIB-527 |
| LIB-10 | LIB\$T[ABLE_]PARSE Argument Block Fields .....  | LIB-540 |
| LIB-11 | Keyword Abbreviation Flags .....  | LIB-554 |
| LIB-12 | Binary Representation of a LIB\$T[ABLE_]PARSE State Transition .....                          | LIB-560 |
| LIB-13 | ASCII Graphics Not Translated to EBCDIC Equivalent by LIB\$TRA_ASC_EBC .....                  | LIB-589 |
| LIB-14 | EBCDIC Graphics Not Translated to ASCII Equivalent by LIB\$TRA_EBC_ASC .....                  | LIB-593 |

---

## Preface

This manual provides users of the OpenVMS operating system with detailed usage and reference information on library routines supplied in the LIB\$ and CVT\$ facilities of the Run-Time Library (RTL).

### Intended Audience

This manual is intended for system and application programmers who want to call Run-Time Library routines.

### Document Structure

This manual is organized into three parts as follows:

- The overview chapter provides a brief overview of the LIB\$ and CVT\$ Run-Time Library facility and lists the LIB\$ routines and their functions. It also provides guidelines and information on using the LIB\$ facility with VAX and Alpha platforms.
- The LIB\$ reference section describes each library routine contained in the LIB\$ Run-Time Library facility. This information is presented using the documentation format described in *OpenVMS Programming Interfaces: Calling a System Routine*. Routine descriptions appear alphabetically by routine name.
- The CVT\$ reference section describes the routines contained in the CVT\$ Run-Time Library facility. This information is presented using the documentation format described in *OpenVMS Programming Interfaces: Calling a System Routine*.

### Related Documents

The Run-Time Library routines are documented in a series of reference manuals. A description of how the Run-Time Library routines are accessed is presented in *OpenVMS Programming Interfaces: Calling a System Routine*. A description of OpenVMS features and functionality available through calls to the LIB\$ Run-Time Library appears in *OpenVMS Programming Concepts Manual*. Descriptions of the other RTL facilities and their corresponding routines are presented in the following books:

**Alpha**

- *OpenVMS Alpha Guide to 64-Bit Addressing*
- *Digital Portable Mathematics Library* ♦

**VAX**

- *OpenVMS VAX RTL Mathematics (MTH\$) Manual* ♦
- *OpenVMS RTL DECTalk (DTK\$) Manual*
- *OpenVMS RTL General Purpose (OTS\$) Manual*

- *OpenVMS RTL Parallel Processing (PPL\$) Manual*
- *OpenVMS RTL Screen Management (SMG\$) Manual*
- *OpenVMS RTL String Manipulation (STR\$) Manual*

Application programmers using any language can refer to the *Guide to Creating OpenVMS Modular Procedures* for writing modular and reentrant code.

High-level language programmers will find additional information on calling Run-Time Library routines in their language reference manuals. Additional information may also be found in the language user's guide provided with your OpenVMS language software.

For a complete list and description of the manuals in the OpenVMS documentation set, see the *Overview of OpenVMS Documentation*.

For additional information on OpenVMS products and services, access the Digital OpenVMS World Wide Web site. Use the following URL:

<http://www.openvms.digital.com>

## Reader's Comments

Digital welcomes your comments on this manual.

Print or edit the online form `SYS$HELP:OPENVMSDOC_COMMENTS.TXT` and send us your comments by:

|          |  |
|----------|--|
| Internet | <b><code>openvmsdoc@zko.mts.dec.com</code></b>   |
| Fax      | 603 881-0120, Attention: OpenVMS Documentation, ZK03-4/U08                             |
| Mail     | OpenVMS Documentation Group, ZK03-4/U08<br>110 Spit Brook Rd.<br>Nashua, NH 03062-2698 |

## How To Order Additional Documentation

Use the following table to order additional documentation or information. If you need help deciding which documentation best meets your needs, call 800-DIGITAL (800-344-4825).

## Telephone and Direct Mail Orders

| Location        | Call                                     | Fax               | Write  |
|-----------------|--|-------------------|--|
| U.S.A.          | DECdirect<br>800-DIGITAL<br>800-344-4825 | Fax: 800-234-2298 | Digital Equipment Corporation<br>P.O. Box CS2008<br>Nashua, NH 03061   |
| Puerto Rico     | 809-781-0505                             | Fax: 809-749-8300 | Digital Equipment Caribbean, Inc.<br>3 Digital Plaza, 1st Street, Suite 200<br>P.O. Box 11038<br>Metro Office Park<br>San Juan, Puerto Rico 00910-2138 |
| Canada          | 800-267-6215                             | Fax: 613-592-1946 | Digital Equipment of Canada, Ltd.<br>Box 13000<br>100 Herzberg Road<br>Kanata, Ontario, Canada K2K 2A6<br>Attn: DECdirect Sales                        |
| International   | —  | —                 | Local Digital subsidiary or<br>approved distributor  |
| Internal Orders | DTN: 264-4446<br>603-884-4446            | Fax: 603-884-3960 | U.S. Software Supply Business<br>Digital Equipment Corporation<br>10 Cotton Road<br>Nashua, NH 03063-1260  |

ZK-7654A-GE

## Conventions

The name of the OpenVMS AXP operating system has been changed to OpenVMS Alpha. Any references to OpenVMS AXP or AXP are synonymous with OpenVMS Alpha or Alpha.

The following conventions are used to identify information specific to OpenVMS Alpha or to OpenVMS VAX:

**Alpha**

The Alpha icon denotes the beginning of information specific to OpenVMS Alpha.

**VAX**

The VAX icon denotes the beginning of information specific to OpenVMS VAX.

◆

The diamond symbol denotes the end of a section of information specific to OpenVMS Alpha or to OpenVMS VAX.

In this manual, every use of DECwindows and DECwindows Motif refers to DECwindows Motif for OpenVMS software.

The following conventions are also used in this manual:

|  |  |
|--|--|
| Ctrl/ <i>x</i>   | A sequence such as Ctrl/ <i>x</i> indicates that you must hold down the key labeled Ctrl while you press another key or a pointing device button.  |
| PF1 <i>x</i> or<br>GOLD <i>x</i>                                   | A sequence such as PF1 <i>x</i> or GOLD <i>x</i> indicates that you must first press and release the key labeled PF1 or GOLD and then press and release another key or a pointing device button.<br>GOLD key sequences can also have a slash (/), dash (-), or underscore (_) as a delimiter in EVE commands.  |
| <span style="border: 1px solid black; padding: 2px;">Return</span> | In examples, a key name enclosed in a box indicates that you press a key on the keyboard. (In text, a key name is not enclosed in a box.)  |
| ...  | Horizontal ellipsis points in examples indicate one of the following possibilities: <ul style="list-style-type: none"><li>• Additional optional arguments in a statement have been omitted.</li><li>• The preceding item or items can be repeated one or more times.</li><li>• Additional parameters, values, or other information can be entered.</li></ul> |
| .  | Vertical ellipsis points indicate the omission of items from a code example or command format; the items are omitted because they are not important to the topic being discussed.  |
| ( )  | In command format descriptions, parentheses indicate that, if you choose more than one option, you must enclose the choices in parentheses.  |
| [ ]  | In command format descriptions, brackets indicate optional elements. You can choose one, none, or all of the options. (Brackets are not optional, however, in the syntax of a directory name in an OpenVMS file specification or in the syntax of a substring specification in an assignment statement.)   |
| { }  | In command format descriptions, braces indicate a required choice of options; you must choose one of the options listed.   |
| <b>boldface text</b>   | Boldface text represents the introduction of a new term or the name of an argument, an attribute, or a reason.<br>Boldface text is also used to show user input in Bookreader versions of the manual.  |
| <i>italic text</i>   | Italic text indicates important information, complete titles of manuals, or variables. Variables include information that varies in system output (Internal error <i>number</i> ), in command lines (/PRODUCER= <i>name</i> ), and in command parameters in text (where <i>device-name</i> contains up to five alphanumeric characters).                     |
| UPPERCASE TEXT   | Uppercase text indicates a command, the name of a routine, the name of a file, or the abbreviation for a system privilege.   |
| Monospace type   | Monospace type indicates code examples and interactive screen displays.<br>In the C programming language, monospace type in text identifies the following elements: keywords, the names of independently compiled external functions and files, syntax summaries, and references to variables or identifiers introduced in an example.                       |

A hyphen at the end of a command format description, command line, or code line indicates that the command or statement continues on the following line.

numbers

All numbers in text are assumed to be decimal unless otherwise noted. Nondecimal radices—binary, octal, or hexadecimal—are explicitly indicated.



---

## Overview of the LIB\$ Facility

### 1.1 Run-Time Library LIB\$ Routines

This manual discusses the Run-Time Library (RTL) LIB\$ routines that perform general purpose (library) functions. One of the functions of the LIB\$ facility is to provide a callable interface to components of OpenVMS operating systems that are difficult to use in a high-level language. LIB\$ routines allow access to the following:

- System services
- The command language interpreter (CLI)
- Some VAX machine instructions or the equivalent Alpha instructions

In addition, LIB\$ routines allow you to perform the following operations:

- Allocate the resources that your process needs, such as virtual memory and event flags
- Convert data types for I/O
- Enable detection of hardware exceptions ♦
- Establish condition handlers ♦
- Generate and display timing statistics while your program is running
- Get and put strings in the process common storage area
- Obtain records from devices
- Obtain the system date and time in various formats
- Process cross-reference data
- Process DECnet/OSI full names for OpenVMS VAX systems ♦
- Search for specified files
- Set up and use binary trees
- Signal exceptions

VAX

VAX

VAX

#### 1.1.1 64-Bit Addressing Support

Alpha

On Alpha systems, the Run-Time Library (LIB\$) routines provide 64-bit virtual addressing capabilities as follows:

- Most routines now accept 64-bit addresses for arguments passed by reference. Footnotes in the Reference Section of this manual indicate those routines that do not.
- Most routines also accept either 32-bit or 64-bit descriptors for arguments passed by descriptor. Footnotes in the Reference Section of this manual indicate those routines that do not.

# Overview of the LIB\$ Facility

## 1.1 Run-Time Library LIB\$ Routines

- In some cases, a new routine was added to support a 64-bit addressing or data capability. These routines carry the same name as the original routine but with a `_64` suffix. In general, both versions of the routine support 64-bit addressing, but the routine with the `_64` suffix also supports additional 64-bit capability. The 32-bit capabilities of the original routine are unchanged.
- Specialized routines create and manipulate storage zones in the 64-bit virtual address space. The names of these routines are the same as their 32-bit counterparts but with a `_64` suffix. One example is `LIB$CREATE_VM_ZONE` and `LIB$CREATE_VM_ZONE_64`. `LIB$CREATE_VM_ZONE` creates a storage zone in the 32-bit virtual address space, and `LIB$CREATE_VM_ZONE_64` creates a storage zone in the 64-bit virtual address space. The function of the original routine is unchanged.

See the *OpenVMS Alpha Guide to 64-Bit Addressing* for more information about 64-bit virtual addressing capabilities. ♦

### 1.1.2 The LIB\$ Routines

Table 1-1 lists all of the LIB\$ routines and their functions.

**Table 1-1 LIB\$ Routines**

| Routine Name                              | Function   |
|---|--|
| <code>LIB\$ADAWI</code>                   | Add adjacent word with interlock.                    |
| <code>LIB\$ADDX</code>                    | Add two multiple-precision binary numbers.           |
| <code>LIB\$ADD_TIMES</code>               | Add two quadwords times.                             |
| <code>LIB\$ANALYZE_SDESC</code>           | Analyze a string descriptor.                         |
| <code>‡LIB\$ANALYZE_SDESC_64</code>       | Analyze a string descriptor.                         |
| <code>LIB\$ASN_WTH_MBX</code>             | Assign a channel to a mailbox.                       |
| <code>LIB\$AST_IN_PROG</code>             | Check for active AST.                                |
| <code>LIB\$ATTACH</code>                  | Attach a terminal to a process.                      |
| <code>LIB\$BBCCI</code>                   | Test and clear a bit with interlock.                 |
| <code>LIB\$BBSSI</code>                   | Test and set a bit with interlock.                   |
| <code>LIB\$BUILD_NODESPEC</code>          | Build a node-name specification.                     |
| <code>LIB\$CALLG</code>                   | Call a procedure with a general argument list.       |
| <code>‡LIB\$CALLG_64</code>               | Call a procedure with a general argument list.       |
| <code>LIB\$CHAR</code>                    | Transform a byte to the first character of a string. |
| <code>LIB\$COMPARE_NODENAME</code>        | Compare two node names.                              |
| <code>LIB\$COMPRESS_NODENAME</code>       | Compress a node name to its short form equivalent.   |
| <code>LIB\$CONVERT_DATE_STRING</code>     | Convert a date string to a quadword.                 |
| <code>LIB\$CRC</code>                     | Calculate a cyclic redundancy check (CRC).           |
| <code>LIB\$CRC_TABLE</code>               | Construct a cyclic redundancy check (CRC) table.     |
| <code>LIB\$CREATE_DIR</code>              | Create a directory.                                  |
| <code>LIB\$CREATE_USER_VM_ZONE</code>     | Create a user-defined storage zone.                  |
| <code>‡LIB\$CREATE_USER_VM_ZONE_64</code> | Create a user-defined storage zone.                  |

‡Alpha specific.

(continued on next page)

## Overview of the LIB\$ Facility

### 1.1 Run-Time Library LIB\$ Routines

**Table 1-1 (Cont.) LIB\$ Routines**

| Routine Name                 | Function   |
|------------------------------|--|
| LIB\$CREATE_VM_ZONE          | Create a new storage zone.   |
| ‡LIB\$CREATE_VM_ZONE_64      | Create a new storage zone.   |
| LIB\$CRF_INS_KEY             | Insert a key in the cross-reference table.                                   |
| LIB\$CRF_INS_REF             | Insert a reference to a key in the cross-reference table.                    |
| LIB\$CRF_OUTPUT              | Output some cross-reference table information.                               |
| LIB\$CURRENCY                | Get the system currency symbol.  |
| LIB\$CVTF_FROM_INTERNAL_TIME | Convert internal time to external time (F-floating value).                   |
| LIB\$CVTF_TO_INTERNAL_TIME   | Convert external time to internal time (F-floating value).                   |
| LIB\$CVT_DX_DX               | Convert the specified data type.   |
| LIB\$CVT_FROM_INTERNAL_TIME  | Convert internal time to external time.                                      |
| LIB\$CVT_TO_INTERNAL_TIME    | Convert external time to internal time.                                      |
| LIB\$CVT_VECTIM              | Convert 7-word vector to internal time.                                      |
| LIB\$CVT_xTB                 | Convert numeric text to binary.  |
| ‡LIB\$CVT_xTB_64             | Convert numeric text to binary.  |
| LIB\$DATE_TIME               | Return the date and time as a string.  |
| LIB\$DAY                     | Return the day number as a longword integer.                                 |
| LIB\$DAY_OF_WEEK             | Return the numeric day of the week.  |
| LIB\$DECODE_FAULT            | Decode instruction stream during a fault. <sup>1</sup>                       |
| LIB\$DEC_OVER                | Enable or disable decimal overflow detection. <sup>1</sup>                   |
| LIB\$DELETE_FILE             | Delete one or more files.  |
| LIB\$DELETE_LOGICAL          | Delete a logical name.   |
| LIB\$DELETE_SYMBOL           | Delete a CLI symbol.   |
| LIB\$DELETE_VM_ZONE          | Delete a virtual memory zone.  |
| ‡LIB\$DELETE_VM_ZONE_64      | Delete a virtual memory zone.  |
| LIB\$DIGIT_SEP               | Get the digit separator symbol.  |
| LIB\$DISABLE_CTRL            | Disable CLI interception of control characters.                              |
| LIB\$DO_COMMAND              | Execute the specified command.   |
| LIB\$EDIV                    | Perform an extended-precision divide.  |
| LIB\$EMODD                   | Perform extended multiply and integerize for D-floating values.              |
| LIB\$EMODF                   | Perform extended multiply and integerize for F-floating values.              |
| LIB\$EMODG                   | Perform extended multiply and integerize for G-floating values.              |
| LIB\$EMODH                   | Perform extended multiply and integerize for H-floating values. <sup>1</sup> |
| LIB\$EMUL                    | Perform an extended-precision multiply.                                      |
| LIB\$ENABLE_CTRL             | Enable CLI interception of control characters.                               |

<sup>1</sup>Available only on OpenVMS VAX systems and for translated VAX applications running on OpenVMS Alpha systems.

‡Alpha specific.

(continued on next page)

# Overview of the LIB\$ Facility

## 1.1 Run-Time Library LIB\$ Routines

Table 1-1 (Cont.) LIB\$ Routines

| Routine Name                | Function  |
|-----------------------------|---|
| LIB\$ESTABLISH              | Establish a condition handler. <sup>1 2</sup>   |
| LIB\$EXPAND_NODENAME        | Expand a node name to its full name equivalent.   |
| LIB\$EXTV                   | Extract a field and sign-extend.  |
| LIB\$EXTZV                  | Extract a zero-extended field.  |
| LIB\$FFx                    | Find the first clear or set bit.  |
| LIB\$FID_TO_NAME            | Convert a device and file ID to a file specification.   |
| LIB\$FILE_SCAN              | Perform a file scan.  |
| LIB\$FILE_SCAN_END          | End a file scan.  |
| LIB\$FIND_FILE              | Find a file.  |
| LIB\$FIND_FILE_END          | End of find file.   |
| LIB\$FIND_IMAGE_SYMBOL      | Merge activate an image symbol.   |
| LIB\$FIND_VM_ZONE           | Find the next valid zone.   |
| ‡LIB\$FIND_VM_ZONE_64       | Find the next valid zone.   |
| LIB\$FIT_NODENAME           | Fit a node name into an output field.   |
| LIB\$FIXUP_FLT              | Fix floating reserved operand. <sup>1</sup>   |
| LIB\$FLT_UNDER              | Detect a floating-point underflow. <sup>1</sup>   |
| LIB\$FORMAT_DATE_TIME       | Format a date and/or time.  |
| †LIB\$FORMAT_SOGW_PROT      | Format protection mask.   |
| LIB\$FREE_DATE_TIME_CONTEXT | Free the context used to format a date.   |
| LIB\$FREE_EF                | Free an event flag.   |
| LIB\$FREE_LUN               | Free a logical unit number.   |
| LIB\$FREE_TIMER             | Free timer storage.   |
| LIB\$FREE_VM                | Free virtual memory from the program region.  |
| ‡LIB\$FREE_VM_64            | Free virtual memory from the program region.  |
| LIB\$FREE_VM_PAGE           | Free a virtual memory page.   |
| ‡LIB\$FREE_VM_PAGE_64       | Free a virtual memory page.   |
| LIB\$GETDVI                 | Get device/volume information.  |
| LIB\$GETJPI                 | Get job/process information.  |
| LIB\$GETQUI                 | Get queue information.  |
| LIB\$GETSYI                 | Get systemwide information.   |
| †LIB\$GET_ACCNAM            | Get access name table for a security object identified by name.                                     |
| †LIB\$GET_ACCNAM_BY_CONTEXT | Get access name table for a security object identified by \$GET_SECURITY or \$SET_SECURITY context. |
| LIB\$GET_COMMAND            | Get line from SYS\$COMMAND.   |
| LIB\$GET_COMMON             | Get string from common area.  |
| ‡LIB\$GET_CURR_INVO_CONTEXT | Get current invocation context.   |

<sup>1</sup>Available only on OpenVMS VAX systems and for translated VAX applications running on OpenVMS Alpha systems.

<sup>2</sup>This routine or an equivalent mechanism is supplied by compilers on OpenVMS Alpha systems.

†VAX specific.

‡Alpha specific.

(continued on next page)

## Overview of the LIB\$ Facility

### 1.1 Run-Time Library LIB\$ Routines

**Table 1-1 (Cont.) LIB\$ Routines**

| Routine Name                 | Function   |
|------------------------------|--|
| LIB\$GET_DATE_FORMAT         | Return the user's date input format.   |
| LIB\$GET_EF                  | Get an event flag.   |
| LIB\$GET_FOREIGN             | Get foreign command line.  |
| LIB\$GET_FULLNAME_OFFSET     | Get the offset to the starting position of the most significant part of a full name. |
| LIB\$GET_HOSTNAME            | Get host node name.  |
| LIB\$GET_INPUT               | Get line from SYS\$INPUT.  |
| ‡LIB\$GET_INVO_CONTEXT       | Get invocation context.  |
| ‡LIB\$GET_INVO_HANDLE        | Get invocation handle.   |
| LIB\$GET_LUN                 | Get logical unit number.   |
| LIB\$GET_MAXIMUM_DATE_LENGTH | Get the maximum possible date/time string length.                                    |
| ‡LIB\$GET_PREV_INVO_CONTEXT  | Get previous invocation context.   |
| ‡LIB\$GET_PREV_INVO_HANDLE   | Get previous invocation handle.  |
| LIB\$GET_SYMBOL              | Get the value of a CLI symbol.   |
| LIB\$GET_USERS_LANGUAGE      | Return the user's language choice.   |
| LIB\$GET_VM                  | Allocate virtual memory.   |
| ‡LIB\$GET_VM_64              | Allocate virtual memory.   |
| LIB\$GET_VM_PAGE             | Get a virtual memory page.   |
| ‡LIB\$GET_VM_PAGE_64         | Get a virtual memory page.   |
| LIB\$ICHAR                   | Convert the first character of a string to an integer.                               |
| LIB\$INDEX                   | Index to relative position of substring.   |
| LIB\$INIT_DATE_TIME_CONTEXT  | Initialize the context used in formatting date/time strings.                         |
| LIB\$INIT_TIMER              | Initialize times and counts.   |
| LIB\$INSERT_TREE             | Insert entry in a balanced binary tree.  |
| ‡LIB\$INSERT_TREE_64         | Insert entry in a balanced binary tree.  |
| LIB\$INSQHI                  | Insert entry at the head of a queue.   |
| ‡LIB\$INSQHIQ                | Insert entry at the head of a queue.   |
| LIB\$INSQTI                  | Insert entry at the tail of a queue.   |
| ‡LIB\$INSQTIQ                | Insert entry at the tail of a queue.   |
| LIB\$INSV                    | Insert a variable bit field.   |
| LIB\$INT_OVER                | Detect integer overflow. <sup>1</sup>  |
| LIB\$LEN                     | Return the length of a string as a longword.   |
| LIB\$LOCC                    | Locate a character.  |
| LIB\$LOOKUP_KEY              | Look up keyword in table.  |
| LIB\$LOOKUP_TREE             | Look up an entry in a balanced binary tree.  |
| ‡LIB\$LOOKUP_TREE_64         | Look up an entry in a balanced binary tree.  |
| LIB\$LP_LINES                | Specify the number of lines on each printer page.                                    |

<sup>1</sup>Available only on OpenVMS VAX systems and for translated VAX applications running on OpenVMS Alpha systems.  
‡Alpha specific.

(continued on next page)

# Overview of the LIB\$ Facility

## 1.1 Run-Time Library LIB\$ Routines

Table 1-1 (Cont.) LIB\$ Routines

| Routine Name             | Function   |
|--------------------------|--|
| LIB\$MATCHC              | Match characters, return relative position.                      |
| LIB\$MATCH_COND          | Match condition values.  |
| LIB\$MOVC3               | Move characters.   |
| LIB\$MOVC5               | Move characters with fill.                                       |
| LIB\$MOVTC               | Move translated characters.                                      |
| LIB\$MOVTUC              | Move translated until character.                                 |
| LIB\$MULTF_DELTA_TIME    | Multiply delta time by F-floating scalar.                        |
| LIB\$MULT_DELTA_TIME     | Multiply delta time by scalar.                                   |
| †LIB\$PARSE_ACCESS_CODE  | Parse access-encoded name string.                                |
| †LIB\$PARSE_SOGW_PROT    | Parse protection string.   |
| LIB\$PAUSE               | Pause program execution.   |
| LIB\$POLYD               | Evaluate polynomials for D-floating values.                      |
| LIB\$POLYF               | Evaluate polynomials for F-floating values.                      |
| LIB\$POLYG               | Evaluate polynomials for G-floating values.                      |
| LIB\$POLYH               | Evaluate polynomials for H-floating values. <sup>1</sup>         |
| LIB\$PUT_COMMON          | Put string into common area.                                     |
| ‡LIB\$PUT_INVO_REGISTERS | Put invocation registers.  |
| LIB\$PUT_OUTPUT          | Put line to SYS\$OUTPUT.   |
| LIB\$RADIX_POINT         | Radix point symbol.  |
| LIB\$REMQHI              | Remove entry from head of queue.                                 |
| ‡LIB\$REMQHIQ            | Remove entry from head of queue.                                 |
| LIB\$REMQTI              | Remove entry from tail of queue.                                 |
| ‡LIB\$REMQTIQ            | Remove entry from tail of queue.                                 |
| LIB\$RENAME_FILE         | Rename one or more files.  |
| LIB\$RESERVE_EF          | Reserve an event flag.   |
| LIB\$RESET_VM_ZONE       | Reset virtual memory zone.                                       |
| ‡LIB\$RESET_VM_ZONE_64   | Reset virtual memory zone.                                       |
| LIB\$REVERT              | Revert to the handler of the procedure activator. <sup>1 2</sup> |
| LIB\$RUN_PROGRAM         | Run new program.   |
| LIB\$SCANC               | Scan for characters and return relative position.                |
| LIB\$SCOPY_DXDX          | Copy source string by descriptor to destination.                 |
| LIB\$SCOPY_R_DX          | Copy source string by reference to destination.                  |
| ‡LIB\$SCOPY_R_DX_64      | Copy source string by reference to destination.                  |
| LIB\$SET_LOGICAL         | Set logical name.  |
| LIB\$SET_SYMBOL          | Set the value of a CLI symbol.                                   |
| LIB\$SFREE1_DD           | Free one or more dynamic strings.                                |

<sup>1</sup>Available only on OpenVMS VAX systems and for translated VAX applications running on OpenVMS Alpha systems.

<sup>2</sup>This routine or an equivalent mechanism is supplied by compilers on OpenVMS Alpha systems.

†VAX specific.

‡Alpha specific.

(continued on next page)

## Overview of the LIB\$ Facility

### 1.1 Run-Time Library LIB\$ Routines

**Table 1–1 (Cont.) LIB\$ Routines**

| Routine Name            | Function  |
|-------------------------|---|
| LIB\$SFREEN_DD          | Free <i>n</i> dynamic strings.                              |
| LIB\$SGET1_DD           | Get one dynamic string.                                     |
| ‡LIB\$SGET1_DD_64       | Get one dynamic string.                                     |
| LIB\$SHOW_TIMER         | Show accumulated times and counts.                          |
| LIB\$SHOW_VM            | Show virtual memory statistics.                             |
| ‡LIB\$SHOW_VM_64        | Show virtual memory statistics.                             |
| LIB\$SHOW_VM_ZONE       | Display information about a virtual memory zone.            |
| ‡LIB\$SHOW_VM_ZONE_64   | Display information about a virtual memory zone.            |
| LIB\$SIGNAL             | Signal exception condition.                                 |
| LIB\$SIG_TO_RET         | Convert a signaled message to a return status.              |
| LIB\$SIG_TO_STOP        | Convert a signaled condition to a signaled stop.            |
| LIB\$SIM_TRAP           | Simulate floating trap. <sup>1</sup>                        |
| LIB\$SKPC               | Skip equal characters.                                      |
| LIB\$SPANC              | Skip selected characters.                                   |
| LIB\$SPAWN              | Spawn a subprocess.   |
| LIB\$STAT_TIMER         | Return accumulated time and count statistics.               |
| LIB\$STAT_VM            | Return virtual memory statistics.                           |
| ‡LIB\$STAT_VM_64        | Return virtual memory statistics.                           |
| LIB\$STOP               | Stop execution and signal the condition.                    |
| LIB\$SUBX               | Perform multiple-precision binary subtraction.              |
| LIB\$SUB_TIMES          | Subtract two quadword times.                                |
| LIB\$SYS_ASCTIM         | Invoke \$ASCTIM to convert binary time to ASCII.            |
| LIB\$SYS_FAO            | Invoke \$FAO system service to format output.               |
| LIB\$SYS_FAOL           | Invoke \$FAOL system service to format output.              |
| ‡LIB\$SYS_FAOL_64       | Invoke \$FAOL system service to format output.              |
| LIB\$SYS_GETMSG         | Invoke \$GETMSG system service to get message text.         |
| LIB\$TABLE_PARSE        | Implement a table-driven, finite-state parser.              |
| LIB\$TPARSE             | Implement a table-driven, finite-state parser. <sup>1</sup> |
| LIB\$TRAVERSE_TREE      | Traverse a balanced binary tree.                            |
| ‡LIB\$TRAVERSE_TREE_64  | Traverse a balanced binary tree.                            |
| LIB\$TRA_ASC_EBC        | Translate ASCII to EBCDIC.                                  |
| LIB\$TRA_EBC_ASC        | Translate EBCDIC to ASCII.                                  |
| LIB\$TRIM_FILESPEC      | Fit a long file specification into a fixed field.           |
| LIB\$TRIM_FULLNAME      | Trim a full name to fit into a desired output field.        |
| LIB\$VERIFY_VM_ZONE     | Verify a virtual memory zone.                               |
| ‡LIB\$VERIFY_VM_ZONE_64 | Verify a virtual memory zone.                               |
| LIB\$WAIT               | Wait a specified period of time.                            |

<sup>1</sup>Available only on OpenVMS VAX systems and for translated VAX applications running on OpenVMS Alpha systems.  
‡Alpha specific.

# Overview of the LIB\$ Facility

## 1.2 Translated Version of LIB\$ Facility (Alpha Only)

### 1.2 Translated Version of LIB\$ Facility (Alpha Only)

**Alpha**

The RTL LIB\$ facility exists in two forms on OpenVMS Alpha systems: native and translated. The translated LIB\$ library contains routines specific to VAX systems only, and are executed in the Translated Image Environment (TIE). These routines are not available to native OpenVMS Alpha programs. See *DECmigrate for OpenVMS AXP Systems Translating Images* for additional information on using translated images and the TIE.

Table 1–2 lists the translated LIB\$ routines.

**Table 1–2 Translated LIB\$ Routines (Alpha Only)**

| Routine Name      | Restriction  |
|-------------------|--|
| LIB\$DECODE_FAULT | Decodes VAX instructions.  |
| LIB\$DEC_OVER     | Applies to VAX PSL only.   |
| LIB\$ESTABLISH    | Supported by compilers on OpenVMS Alpha systems.                         |
| LIB\$FIXUP_FLT    | Applies to VAX PSL only.   |
| LIB\$FLT_UNDER    | Applies to VAX PSL only.   |
| LIB\$INT_OVER     | Applies to VAX PSL only.   |
| LIB\$REVERT       | Supported by compilers on OpenVMS Alpha systems.                         |
| LIB\$SIM_TRAP     | Applies to VAX code.   |
| LIB\$TPARSE       | Requires action routine interface changes. Replaced by LIB\$TABLE_PARSE. |

LIB\$ routines that are called using JSB linkages may function differently on OpenVMS VAX and OpenVMS Alpha systems. See *OpenVMS Programming Interfaces: Calling a System Routine* for more information on using JSB linkages.♦

### 1.3 Run-Time Library CVT\$ Facility

This manual describes the Run-Time Library CVT\$ facility and its CVT\$CONVERT\_FLOAT routine. The CVT\$ facility lets you convert data stored in one OpenVMS data type into data for another data type. For example, CVT\$CONVERT\_FLOAT converts data in one of several floating-point data types to another floating-point data type.

---

## **LIB\$ Reference Section**

This section contains detailed discussions of the routines provided by the OpenVMS RTL Library (LIB\$) Facility.



---

## LIB\$ADAWI

### Add Aligned Word with Interlock

The Add Aligned Word with Interlock routine allows the user to perform an interlocked add operation using an aligned word.

#### Format

LIB\$ADAWI add ,sum ,sign

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **add**

OpenVMS usage: word\_signed  
type: word (signed)  
access: read only  
mechanism: by reference

The addend operand to be added to the value of **sum**. The **add** argument is the address of a signed word that contains the addend operand.

##### **sum**

OpenVMS usage: word\_signed  
type: word integer (signed)  
access: modify  
mechanism: by reference

The word to which **add** is added. The **sum** argument is the address of a signed word integer containing this value. The **add** operand is added to the **sum** operand, and the value of the **sum** argument is replaced by the result of this addition. The **sum** argument must be word-aligned; in other words, its address must be a multiple of 2.

##### **sign**

OpenVMS usage: word\_signed  
type: word integer (signed)  
access: write only  
mechanism: by reference

Sign of the **sum** argument. The **sign** argument is the address of a signed word integer that is assigned the value -1, 0, or 1, depending on whether the new value of **sum** is negative, 0, or positive.

## LIB\$ Routines

### LIB\$ADAWI

#### Description

LIB\$ADAWI allows the user to perform an interlocked add operation using an aligned word, and makes the VAX ADAWI<sup>1</sup> instruction available as a callable routine. This routine also enables the user to implement synchronization primitives for multiprocessing.

The add operation is interlocked against similar operations on other processors in a multiprocessor environment. This provides an atomic addition operation. The destination must be aligned on a word boundary; that is, bit 0 of the address of the sum operand must be 0.

If the addend and the sum operand overlap, the result of the addition, the value of the **sign** argument, and the associated condition codes are unpredictable.

The value of the **sign** argument is useful when LIB\$ADAWI is used to implement locking in a multiprocessing program. For example, a process that is waiting to seize a lock or a resource calls LIB\$ADAWI to add 1 to the sum. When the call returns, the waiting process checks the value of **sign**.

One possible algorithm would interpret the value of **sign** as follows:

| Value of sign Argument | Status of Lock or Resource                                  |
|------------------------|---|
| -1                     | Open lock or free resources                                 |
| 0                      | Closed lock or no free resources, with no processes waiting |
| +1                     | Closed lock or no free resources, with processes waiting    |

In this algorithm, if the value of the **sign** argument is -1, that indicates that the process successfully seized the lock or resource, and other free resources are available. A value of 0 indicates that the process successfully seized the lock or the last available resource. A value of 1 indicates that the process was unable to seize the lock.

It is not sufficient for a waiting process to test the value of **sum**. The result is unpredictable because other processes can alter the value of **sum** after the original process executes the ADAWI instruction but before it tests the value of **sum**. However, a process can safely test the value of **sign** because its value is determined by the ADAWI instruction and is unaffected by other processes' activities.

#### Condition Values Returned

|              |                                 |
|--------------|---------------------------------|
| LIB\$_NORMAL | Routine successfully completed. |
| LIB\$_INTOVF | Integer overflow error.         |

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

---

## LIB\$ADDX

### Add Two Multiple-Precision Binary Numbers

The Add Two Multiple-Precision Binary Numbers routine adds two signed two's complement integers of arbitrary length.

#### Format

LIB\$ADDX addend-array ,augend-array ,resultant-array [,array-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### addend-array

OpenVMS usage: vector\_longword\_signed  
type: unspecified  
access: read only  
mechanism: by reference, array reference

First multiple-precision, signed two's complement integer, which LIB\$ADDX adds to the second two's complement integer. The **addend-array** argument is the address of the array containing the two's complement number to be added.

##### augend-array

OpenVMS usage: vector\_longword\_signed  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Second multiple-precision, signed two's complement integer, which LIB\$ADDX adds to the first two's complement integer. The **augend-array** argument is the address of the array containing the two's complement number.

##### resultant-array

OpenVMS usage: vector\_longword\_signed  
type: unspecified  
access: write only  
mechanism: by reference, array reference

Multiple-precision, signed two's complement integer result of the addition. The **resultant-array** argument is the address of the array into which LIB\$ADDX writes the result of the addition.

##### array-length

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

## LIB\$ Routines

### LIB\$ADDX

Length in longwords of the arrays to be operated on; each array is of length **len**. The **len** argument is the address of a signed longword integer containing the length. The **len** argument must not be negative. This is an optional argument. If omitted, the default is 2.

### Description

LIB\$ADDX adds two signed two's complement integers of arbitrary length. The integers are located in arrays of longwords. The higher addresses of these longwords contain the higher precision parts of the values. The highest-addressed longword contains the sign and 31 bits of precision. The remaining longwords contain 32 bits of precision in each. The number of longwords in each array is specified in the optional argument **len**. The default length is two (2), which corresponds to the OpenVMS quadword data type.

Any two or all three of the first three arguments can be the same.

### Condition Values Returned

|             |  |
|-------------|--|
| SS\$_NORMAL | Routine successfully completed.  |
| SS\$_INTOVF | Integer overflow. The result is correct, except that the sign bit is lost. |

### Example

```
C+
C This Fortran example program shows the use
C of LIB$ADDX.
C-

      INTEGER A(2),B(2),C(2),RETURN
      DATA A/'00000001'x,'7FFF407F'x/
      DATA B/'FFFFFFFF'x,'8000BF80'x/

C+
C The highest addressed longword of "A" is A(2).
C So, "A" represents the integer value ('7FFF407F'x) * 16**7 + 1.
C That is, A(2) is 576447592255193089.
C "B" is the twos complement representation of "-A".
C-

      RETURN = LIB$ADDX(A,B,C)
      TYPE *, 'Let A = 576447592255193089.'
      TYPE *, 'Then A + B is 0.'
      TYPE 1,C(2),C(1)
1     FORMAT(' "A" - "A" is ',1H',I1,I1,3H'x.)
      TYPE *, 'Note that C is C(2) concatenated with C(1).'
```

```
C+
C Let "A" have the value 72057594037927937 = '1000000000000001'x.
C Let "B" have the value 4294967295 = '00000000FFFFFFFF'x.
C-

      A(1) = '00000001'x
      A(2) = '10000000'x
      B(1) = 'FFFFFFFF'x
      B(2) = '00000000'x

C+
C Then "A" + "B" is 72057598332895232.
C-
```

## LIB\$ Routines LIB\$ADDX

```
RETURN = LIB$ADDX(A,B,C)
TYPE *,' '
TYPE *,'LET A = 72057594037927937 and B = 4294967295'
TYPE *,'Then A + B is ',C
TYPE 2,C(2),C(1)
2  FORMAT(' 72057598332895232 is represented as ',1H',Z8.8,Z8.8,3H'x.)
TYPE *,'Recall that 72057598332895232 is C(2) concatenated
1 with C(1).'
```

This Fortran example demonstrates how to call LIB\$ADDX. The output generated by this program is as follows:

```
Let A = 576447592255193089.
Then A + B is 0.
"A" - "A" is '00'x.
Note that C is C(2) concatenated with C(1).
LET A = 72057594037927937 and B = 4294967295
Then A + B is      0      268435457
72057598332895232 is represented as '1000001      0'x.
Recall that 72057598332895232 is C(2) concatenated with C(1).
```

## LIB\$ADD\_TIMES

### Add Two Quadword Times

The Add Two Quadword Times routine adds two internal format times.

#### Format

LIB\$ADD\_TIMES time1 ,time2 ,resultant-time

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### time1

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

First time that LIB\$ADD\_TIMES adds to the second time. The **time1** argument is the address of an unsigned quadword containing the first time to be added. The **time1** argument may be either a delta time or an absolute time; however, at least one of the arguments, **time1** or **time2**, must be a delta time.

##### time2

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Second time that LIB\$ADD\_TIMES adds to the first time. The **time2** argument is the address of an unsigned quadword containing the second time to be added. The **time2** argument may be either a delta time or an absolute time; however, at least one of the arguments, **time1** or **time2**, must be a delta time.

##### resultant-time

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

The result of adding **time1** and **time2**. The **resultant-time** argument is the address of an unsigned quadword containing the result. If both **time1** and **time2** are delta times, then **resultant-time** is a delta time. Otherwise, **resultant-time** is an absolute time.

**Description**

LIB\$ADD\_TIMES adds two OpenVMS internal times. It can add two delta times or a delta time and an absolute time. LIB\$ADD\_TIMES cannot add two absolute times. Delta times must be less than 10,000 days.

**Condition Values Returned**

|                 |                                      |
|-----------------|--------------------------------------|
| LIB\$_NORMAL    | Routine successfully completed.      |
| LIB\$_IVTIME    | Invalid time.                        |
| LIB\$_ONEDELTIM | At least one delta time is required. |
| LIB\$_WRONUMARG | Incorrect number of arguments.       |

---

## LIB\$ANALYZE\_SDESC

### Analyze String Descriptor

The Analyze String Descriptors routine extracts the length and the address at which the data starts for a variety of 32-bit string descriptor classes.

#### Format

LIB\$ANALYZE\_SDESC input-descriptor ,data-length ,data-address

#### Corresponding JSB Entry Point:

LIB\$ANALYZE\_SDESC\_R2

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### input-descriptor

OpenVMS usage: descriptor  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Input descriptor from which LIB\$ANALYZE\_SDESC extracts the length of the data and the address at which the data starts. The **input-descriptor** argument is the address of a descriptor pointing to the input data.

##### data-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the data; LIB\$ANALYZE\_SDESC extracts this length value from the input descriptor. The **data-length** argument is the address of an unsigned word integer into which LIB\$ANALYZE\_SDESC writes the length.

##### data-address

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Starting address of the data; LIB\$ANALYZE\_SDESC extracts this address from the input descriptor. The **data-address** argument is the address of an unsigned longword into which LIB\$ANALYZE\_SDESC writes the starting address of the data.

## Description

LIB\$ANALYZE\_SDESC extracts the length and the address at which the data starts for a variety of 32-bit string descriptor classes. Following is a description of the classes of string descriptors.

| Class | Description         | Restrictions/Notes                            |
|-------|---------------------|---|
| A     | Array               | DSC\$L_ARSIZE must be less than 65,536 bytes. |
| D     | Decimal string      | Treated as class S.                           |
| NCA   | Noncontiguous array | Same as class A.                              |
| S     | Scalar, string      | None.   |
| SD    | Decimal scalar      | Treated as class S.                           |
| VS    | Varying string      | Length returned is CURLEN.                    |
| Z     | Unspecified         | Treated as class S.                           |

See STR\$ANALYZE\_SDESC for a similar routine that signals an error rather than returning a status.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_INVSTRDES | Invalid string descriptor. An array descriptor has an ARSIZE greater than 65,535 bytes, or the class is unsupported. |

## LIB\$ANALYZE\_SDESC\_64 (Alpha Only) Analyze String Descriptor

The Analyze String Descriptor routine extracts the length and the address at which the data starts for a variety of 32-bit and 64-bit string descriptor classes.

### Format

LIB\$ANALYZE\_SDESC\_64 input-descriptor ,data-length ,data-address [,descriptor-type]

### Corresponding JSB Entry Point:

Refer to the LIB\$ANALYZE\_SDESC routine for information about the JSB entry point, LIB\$ANALYZE\_SDESC\_R2. This JSB entry point returns 64-bit results on Alpha systems.

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### input-descriptor

OpenVMS usage: descriptor  
type: longword (unsigned) or quadword (unsigned)  
access: read only  
mechanism: by reference

Input descriptor from which LIB\$ANALYZE\_SDESC\_64 extracts the length of the data and the address at which the data starts. The **input-descriptor** argument is the address of a descriptor pointing to the input data. The input descriptor can be a longword (unsigned) or a quadword (unsigned).

#### data-length

OpenVMS usage: quadword\_unsigned  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Length of the data; LIB\$ANALYZE\_SDESC\_64 extracts this length value from the input descriptor. The **data-length** argument is the address of an unsigned quadword integer into which LIB\$ANALYZE\_SDESC\_64 writes the length.

#### data-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Starting address of the data; LIB\$ANALYZE\_SDESC\_64 extracts this address from the input descriptor. The **data-address** argument is the address of an unsigned quadword into which LIB\$ANALYZE\_SDESC\_64 writes the starting address of the data.

**descriptor-type**

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: write only  
 mechanism: by reference

Flag value indicating the type of input descriptor. The **descriptor-type** argument contains the address of an unsigned longword integer to which LIB\$ANALYZE\_SDESC\_64 writes a zero (0) for a 32-bit input descriptor or a one (1) for a 64-bit descriptor.

This argument is optional.

**Description**

LIB\$ANALYZE\_SDESC\_64 extracts the length and the address at which the data starts for a variety of 32-bit and 64-bit string descriptor classes. Following is a description of the classes of string descriptors:

| Class | Description         | Restrictions/Notes   |
|-------|---------------------|--|
| A     | Array               | For 32-bit descriptors, DSC\$L_ARSIZE must be less than $2^{16}$ , or 65,536, bytes. For 64-bit descriptors, DSC64\$Q_ARSIZE must be less than $2^{64}$ bytes. |
| D     | Decimal string      | Treated as class S.  |
| NCA   | Noncontiguous array | Same as class A.   |
| S     | Scalar, string      | None.  |
| SD    | Decimal scalar      | Treated as class S.  |
| VS    | Varying string      | Length returned is CURLEN.   |
| Z     | Unspecified         | Treated as class S.  |

See STR\$ANALYZE\_SDESC\_64 for a similar routine that signals an error rather than returning a status.

**Condition Values Returned**

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_INVSTRDES | Invalid string descriptor. An array descriptor has an ARSIZE greater than 65,535 bytes, or the class is unsupported. |

---

## LIB\$ASN\_WTH\_MBX

### Assign Channel with Mailbox

The Assign Channel with Mailbox routine assigns a channel to a specified device and associates a mailbox with the device. It returns both the device channel and the mailbox channel.

#### Format

```
LIB$ASN_WTH_MBX device-name [,maximum-message-size] [,buffer-quota] ,device-channel  
                ,mailbox-channel
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### device-name

OpenVMS usage: device\_name  
type: character string  
access: read only  
mechanism: by descriptor

Device name that LIB\$ASN\_WTH\_MBX passes to the \$ASSIGN service. The **device-name** argument is the address of a descriptor pointing to the device name.

##### maximum-message-size

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Maximum message size that can be sent to the mailbox; LIB\$ASN\_WTH\_MBX passes this argument to the \$CREMBX service. The **maximum-message-size** argument is the address of a signed longword integer containing this maximum message size.

##### buffer-quota

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of system dynamic memory bytes that can be used to buffer messages sent to the mailbox; LIB\$ASN\_WTH\_MBX passes this argument to the \$CREMBX service. The **buffer-quota** argument is the address of a signed longword integer containing this buffer quota.

**device-channel**

OpenVMS usage: word\_unsigned  
type: word integer (unsigned)  
access: write only  
mechanism: by reference

Device channel that LIB\$ASN\_WTH\_MBX receives from the \$ASSIGN service. The **device-channel** argument is the address of an unsigned word integer into which \$ASSIGN writes the device channel.

**mailbox-channel**

OpenVMS usage: channel  
type: word integer (unsigned)  
access: write only  
mechanism: by reference

Mailbox channel that LIB\$ASN\_WTH\_MBX receives from the \$CREMBX service. The **mailbox-channel** argument is the address of an unsigned word integer into which \$CREMBX writes the mailbox channel.

## Description

A mailbox is a virtual device used for communication between processes. A channel is the communication path that a process uses to perform I/O operations to a particular device. LIB\$ASN\_WTH\_MBX assigns a channel to a device and associates a mailbox with the device. It returns both the device channel and the mailbox channel to the mailbox.

Normally, a process calls the \$CREMBX system service to create a mailbox and assign a channel and logical name to it. Any process running in the same job and using the same logical name uses the same mailbox.

LIB\$ASN\_WTH\_MBX associates the physical mailbox name with the channel assigned to the device. To create a temporary mailbox for itself and other processes cooperating with it, your program calls LIB\$ASN\_WTH\_MBX. The Run-Time Library routine assigns the channel and creates the temporary mailbox by using the system services \$GETDVIW, \$ASSIGN, and \$CREMBX. Instead of a logical name, the mailbox is identified by a physical device name of the form MB*cu*. The physical device name MB*cu* is made up of the following elements:

MB Indicates that the device is a mailbox  
c Is the controller  
u Is the unit number

The routine returns the channel for this device name to the calling program, which then must pass the mailbox channel to the other programs with which it cooperates. In this way, the cooperating processes access the mailbox by its physical name, instead of by a logical name.

The calling program passes the routine a device name, which specifies the device to which the channel is to be assigned. For this argument (called **device-name**), you may use a logical name. If you do so, the routine attempts one level of logical name translation.

The privilege restrictions and process quotas required for using this routine are those required by the \$GETDVIW, \$CREMBX, and \$ASSIGN system services.

**LIB\$ Routines**  
**LIB\$ASN\_WTH\_MBX**

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

Any condition value returned by the called system services \$ASSIGN, \$CREMBX, \$GETDVI, or the RTL routines LIB\$GET\_EF and LIB\$FREE\_EF.

---

## LIB\$AST\_IN\_PROG

### AST in Progress

The AST in Progress routine indicates whether an AST is currently in progress.

#### Format

LIB\$AST\_IN\_PROG

#### Returns

OpenVMS usage: boolean  
type: boolean  
access: write only  
mechanism: by value

Truth value that indicates whether an AST is currently in progress (value = 1) or not (value = 0).

#### Arguments

None.

#### Description

An asynchronous system trap (AST) is an OpenVMS mechanism for providing a software interrupt when an external event occurs, such as the user entering Ctrl/C. When an external event occurs, the OpenVMS operating system interrupts the execution of the current process and calls a routine that you supply. While that routine is active, the AST is said to be in progress, and the process is said to be executing at AST level. When your AST routine returns control to the original process, the AST is no longer active, and execution continues where it left off.

LIB\$AST\_IN\_PROG indicates to the calling program whether an AST is currently in progress. Your program can call LIB\$AST\_IN\_PROG to determine whether it is executing at AST level and then take appropriate action. This routine is useful if you are writing AST-reentrant code, which takes different actions depending on whether an AST is in progress. For example, the routine might have two separate statically allocated storage areas, one for AST level and one for non-AST level.

LIB\$AST\_IN\_PROG calls the LIB\$FREE\_EF, LIB\$GET\_EF and SYS\$GETJPI routines. If LIB\$AST\_IN\_PROG or any of these routines encounters an error, LIB\$AST\_IN\_PROG calls LIB\$STOP.

#### Condition Values Returned

None.

## LIB\$ Routines

### LIB\$AST\_IN\_PROG

#### Example

```
PROGRAM AST_IN_PROGRESS(INPUT, OUTPUT);
FUNCTION LIB$AST_IN_PROG : INTEGER; EXTERN;
VAR
  ASTVALUE : INTEGER;
BEGIN
  ASTVALUE := LIB$AST_IN_PROG;
  CASE ASTVALUE OF
    0 : WRITELN('AN AST IS NOT IN PROGRESS');
    1 : WRITELN('AN AST IS IN PROGRESS');
  END { of the case statement }
END.
```

This Pascal program determines whether or not an AST is in progress.

---

## LIB\$ATTACH

### Attach Terminal to Process

The Attach Terminal to Process routine requests the calling process's command language interpreter (CLI) to detach the terminal of the calling process and to reattach it to a different process.

#### Format

LIB\$ATTACH process-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**process-id**  
OpenVMS usage: process\_id  
type: longword integer (unsigned)  
access: read only  
mechanism: by reference

Identification of the process to which LIB\$ATTACH requests the calling process to attach its terminal. The **process-id** argument is the address of an unsigned longword integer containing the process identification. The specified process must be currently detached (by means of a SPAWN or ATTACH command or by a call to LIB\$SPAWN or LIB\$ATTACH) and must be part of the caller's job.

#### Description

LIB\$ATTACH requests the calling process's command language interpreter (CLI) to detach the terminal of the calling process and reattach it to a different process. The calling process then hibernates. LIB\$ATTACH provides the same function as the DCL command ATTACH. For more information on ATTACH, see the *OpenVMS DCL Dictionary*.

LIB\$ATTACH is supported for use with the DCL CLI. If used with the Monitor Control Routine (MCR) CLI, the error status LIB\$\_NOCLI is returned. If an image is run directly as a subprocess or detached process, no CLI is present to perform this function. In such cases, the error status LIB\$\_NOCLI is returned.

#### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| SS\$_NONEXPR    | Nonexistent process. The process specified by <b>process-id</b> does not exist.  |
| LIB\$_ATTREQREF | Attach request refused. The specified process could not be attached to. Either it was not detached or it did not belong to the caller's job. |

**LIB\$ Routines**  
**LIB\$ATTACH**

**LIB\$\_NOCLI**

No CLI present to perform function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.

**LIB\$\_UNECLIERR**

Unexpected CLI error. The CLI returned an error status, which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL CLI, please report the problem to Digital by means of a Software Performance Report (SPR).

---

## LIB\$BBCCI

### Test and Clear Bit with Interlock

The Test and Clear Bit with Interlock routine tests and clears a selected bit under memory interlock. LIB\$BBCCI makes the VAX BBCCI<sup>1</sup> instruction available as a callable routine.

#### Format

LIB\$BBCCI position ,bit-zero-address

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

State of the bit before it was cleared by LIB\$BBCCI: 1 if the bit was previously set, and 0 if the bit was previously clear.

#### Arguments

##### position

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Bit position, relative to **bit-zero-address**, of the bit that LIB\$BBCCI tests and clears. The **position** argument is the address of a signed longword integer containing the bit position. A position of zero denotes the low-order bit of the byte base. The bit position is equal to the offset of the bit chosen from the base position. This offset may span the entire range of a signed longword integer; negative offsets access bits in lower addressed bytes.

##### bit-zero-address

OpenVMS usage: unspecified  
type: address  
access: modify  
mechanism: by reference

Address of the byte containing bit 0 of the field that LIB\$BBCCI references. The **bit-zero-address** argument is the location of the base position. The bit that LIB\$BBCCI tests and clears is **position** bits offset from the low bit of **bit-zero-address**.

#### Description

The single bit specified by **position** and **bit-zero-address** is tested, the previous state of the bit remembered, and the bit cleared. The reading of the state of the bit and its clearing are interlocked against similar operations by other processors or devices in the system. The remembered previous state of the bit is then returned as the function value of LIB\$BBCCI.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$ Routines LIB\$BBCCI

### Condition Values Returned

None.

### Example

```
C+
C This Fortran program demonstrates the use of
C LIB$BBCCI.
C-
      INTEGER*4 STATES(4)      ! 128 shared state bits
      COMMON /STATES/ STATES  ! Could be shared memory
      LOGICAL*4 LIB$BBCCI

      IF (LIB$BBCCI (42, STATES)) THEN
        TYPE *, 'State bit 42 was set'
      ELSE
        TYPE *, 'State bit 42 was clear'
      END IF
      END
```

This Fortran example tests and clears bit 42 of array STATES, which is in a COMMON area (possibly shared between two processors).

The output generated by this program is as follows:

```
$ RUN STATE
State bit 42 was clear.
```

---

## LIB\$BBSSI

### Test and Set Bit with Interlock

The Test and Set Bit with Interlock routine tests and sets a selected bit under memory interlock. LIB\$BBSSI makes the VAX BBSSI instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$BBSSI position ,bit-zero-address

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The state of the bit before it was set by LIB\$BBSSI: 1 if it was previously set, and 0 if it was previously clear.

#### Arguments

##### position

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Bit position, relative to **bit-zero-address**, of the bit that LIB\$BBSSI tests and sets. The **position** argument is the address of a signed longword integer containing the bit position. A position of zero denotes the low-order bit of the byte base. The bit position is equal to the offset of the bit chosen from the base position. This offset may span the entire range of a signed longword integer; negative offsets access bits in lower addressed bytes.

##### bit-zero-address

OpenVMS usage: unspecified  
type: address  
access: modify  
mechanism: by reference

Address of the byte containing bit 0 of the field that LIB\$BBSSI references. The **bit-zero-address** argument is the location of the base position. The bit that LIB\$BBSSI tests and sets is **position** bits offset from the low bit of **bit-zero-address**.

#### Description

The single bit specified by **position** and **bit-zero-address** arguments is tested, the previous state of the bit remembered, and the bit set. The reading of the state of the bit and its setting are interlocked against similar operations by other processors or devices in the system. The remembered previous state of the bit is then returned as the function value of LIB\$BBSSI.

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$ Routines LIB\$BBSSI

### Condition Values Returned

None.

### Example

```
C+
C This Fortran example program demonstrates
C the use of LIB$BBSSI.
C-
      INTEGER*4 STATES(4)      ! 128 shared state bits
      COMMON /STATES/ STATES  ! Could be shared memory
      LOGICAL*4 LIB$BBSSI

      IF (LIB$BBSSI (104, STATES)) THEN
        TYPE *, 'State bit 104 was set'
      ELSE
        TYPE *, 'State bit 104 was clear'
      END IF
      END
```

This Fortran example tests and sets bit 104 of array STATES, which is in a COMMON storage area (possibly shared between two processors).

The output generated by this program is as follows:

```
$ RUN STATEB
State bit 104 was clear.
```

---

## LIB\$BUILD\_NODESPEC

### Build a Node-Name Specification

The Build a Node-Name Specification routine builds a node-name specification from the primary node name. The output node-name specification can be used for other node-name parsing operations.†

#### Format

LIB\$BUILD\_NODESPEC primary-nodename, nodespec [acs] [,secondary-nodename] [,nodespec-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### primary-nodename

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Primary node name. The **primary-nodename** argument contains the address of a descriptor pointing to this node-name string. The primary node name should not contain unnecessary double quotation marks (that is, double quotation marks (")) that are not part of a simple name within the node name).

The error LIB\$\_INVARG is returned if **primary-nodename** points to a null string. The error LIB\$\_INVSTRDES is returned if **primary-nodename** is an invalid descriptor.

##### nodespec

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Node-name specification. The **nodespec** argument contains the address of a descriptor pointing to this output node-name specification string. LIB\$BUILD\_NODESPEC writes the output node-name specification into the buffer pointed to by the **nodespec** descriptor.

The error LIB\$\_INVSTRDES is returned if **nodespec** is an invalid descriptor.

The length field of the **nodespec** descriptor is not updated unless **nodespec** is a dynamic descriptor with a length less than the resultant node-name specification. Refer to the *OpenVMS RTL String Manipulation (STR\$) Manual* for dynamic string descriptor usage.

The **nodespec** argument contains an unusable result when LIB\$BUILD\_NODESPEC returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$BUILD\_NODESPEC

#### **acs**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Access control string. The **acs** argument contains the address of a descriptor pointing to this access control string. The access control string must be a quoted string.

The error LIB\$\_INVSTRDES is returned if **acs** is an invalid descriptor.

#### **secondary-nodename**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Secondary node name. The **secondary-nodename** argument contains the address of a descriptor pointing to this secondary node-name string.

The error LIB\$\_INVSTRDES is returned if **secondary-nodename** is an invalid descriptor.

#### **nodespec-length**

OpenVMS usage: unsigned\_word  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the output node-name specification. The **nodespec-length** argument is the address of an unsigned word that contains this length in bytes.

The **nodespec-length** argument contains an unusable result when LIB\$BUILD\_NODESPEC returns in error.

## Description

This routine builds the parsable form of a node name as the output node-name specification from the network usable form. Refer to LIB\$GET\_HOSTNAME for the definitions of both the parsable form and the network usable form.

The network usable form is specified by the argument **primary-nodename**. If **primary-nodename** contains special characters, it is enclosed by a pair of double quotation marks (" ") to build the node-name specification. The double quotation marks prevent the special characters from being recognized as terminator characters and enables correct parsing of the node-name syntax.

If you enclose **primary-nodename** in a pair of double quotation marks, any double quotation marks that are part of any simple names within **primary-nodename** are doubled (that is, each double quotation mark (") is turned into two double quotation marks (""). LIB\$BUILD\_NODESPEC checks if the fully quoted primary node name exceeds 1024 characters. The error condition LIB\$\_NODTOOLNG is returned if this is the case.

To form the output node-name specification, the fully quoted primary node name is concatenated with the access control string (if supplied) and the double colons and is followed by the secondary node name (if supplied).

This routine does not validate any of the input arguments to ensure they can form a syntactically valid node name when they are concatenated.

If the routine overflows the output buffer pointed to by **nodespec**, the output node-name specification is truncated, and the alternate successful status LIB\$\_STRTRU is returned.

The **nodespec-length** argument, if supplied, is always set to the length of the node-name specification that is written into the output buffer pointed to by **nodespec**.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_STRTRU    | Routine successfully completed. Characters are truncated in the output buffer pointed to by the <b>nodespec</b> argument. |
| LIB\$_INVARG    | Invalid argument. The <b>primary-nodename</b> argument points to a null string.   |
| LIB\$_INVSTRDES | Invalid string descriptor.  |
| LIB\$_WRONUMARG | Wrong number of arguments.  |
| LIB\$_NODTOOLNG | The primary node name after quoting exceeds 1024 characters.  |

Any condition value returned by LIB\$SCOPY\_DXDX.

---

## LIB\$CALLG

### Call Routine with General Argument List

The Call Routine with General Argument List routine calls a routine with an argument list specified as an array of longwords, the first of which is a count of the remaining longwords. LIB\$CALLG is a callable version of the VAX CALLG instruction.<sup>1</sup>

#### Format

LIB\$CALLG argument-list ,user-procedure

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

Return value, if any, of the called routine. This value is not changed by LIB\$CALLG.

#### Arguments

##### argument-list

OpenVMS usage: arg\_list  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Argument list that LIB\$CALLG uses to call the specified routine. The **argument-list** argument is the address of an array of longwords containing the argument list. The first longword must contain the count of the remaining longwords. The maximum value of the count is 255.

##### user-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

Routine that LIB\$CALLG calls with the specified argument list.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

### **Description**

LIB\$CALLG is useful for calling routines that accept variable-length argument lists when the number of arguments to be passed is not known until execution time. LIB\$CALLG can also be used to call such routines from strongly typed languages, which require routines to be declared as having a fixed number of arguments.

### **Condition Values Returned**

None.

## LIB\$CALLG\_64 (Alpha Only) Call Routine with General Argument List

The Call Routine with General Argument List routine calls a routine with an argument list specified as an array of quadwords, the first of which is a count of the remaining quadwords.

### Format

LIB\$CALLG\_64 argument-list ,user-procedure

### Returns

OpenVMS usage: quadword\_unsigned  
type: quadword (unsigned)  
access: write only  
mechanism: by value

Return value, if any, of the called routine. This value is not changed by LIB\$CALLG\_64.

### Arguments

#### **argument-list**

OpenVMS usage: arg\_list  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Argument list that LIB\$CALLG\_64 uses to call the specified routine. The **argument-list** argument is the address of an array of quadwords containing the argument list. The first quadword must contain the count of the remaining quadwords. The maximum value of the count is 255.

#### **user-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

Routine that LIB\$CALLG\_64 calls with the specified argument list.

### Description

LIB\$CALLG\_64 is useful for calling routines that accept variable-length argument lists when the number of arguments to be passed is not known until execution time. LIB\$CALLG\_64 can also be used to call such routines from strongly typed languages, which require routines to be declared as having a fixed number of arguments.

### Condition Values Returned

None.

---

## LIB\$CHAR

### Transform Byte to First Character of String

The Transform Byte to First Character of String routine transforms a single 8-bit ASCII character to an ASCII string consisting of a single character followed by trailing spaces, if needed, to fill out the string. The range of the input byte is 0 through 255.

#### Format

LIB\$CHAR one-character-string ,ascii-code

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### one-character-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

ASCII character string consisting of a single character followed by trailing spaces, if needed, that LIB\$CHAR creates when it transforms the ASCII character code. The **one-character-string** argument is the address of a descriptor pointing to the character string that LIB\$CHAR writes.

##### ascii-code

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Single 8-bit ASCII character code that LIB\$CHAR transforms to an ASCII string. The **ascii-code** argument is the address of an unsigned byte containing the ASCII character code.

#### Description

LIB\$CHAR is the inverse of LIB\$ICHAR. (See the description of LIB\$ICHAR.) LIB\$CHAR is not a binary-to-ASCII conversion routine. LIB\$CHAR merely interprets **ascii-code** as an ASCII character code and converts it to a string.

## LIB\$ Routines LIB\$CHAR

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Routine successfully completed, but the string was truncated. The destination string could not contain all of the characters.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |

---

## LIB\$COMPARE\_NODENAME

### Compare Two Node Names

The Compare Two Node Names routine compares two node names to see if they resolve to the same full name.†

#### Format

LIB\$COMPARE\_NODENAME nodename1 ,nodename2 ,comparison-result

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

##### **nodename1**

OpenVMS usage: char\_string  
 type: character string  
 access: read only  
 mechanism: by descriptor

First node name to be compared. The **nodename1** argument contains the address of a descriptor pointing to this node-name string.

The error LIB\$\_INVARG is returned if **nodename1** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if **nodename1** is an invalid descriptor.

##### **nodename2**

OpenVMS usage: char\_string  
 type: character string  
 access: read only  
 mechanism: by descriptor

Second node name to be compared. The **nodename2** argument contains the address of a descriptor pointing to this node-name string.

The error LIB\$\_INVARG is returned if **nodename2** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if **nodename2** is an invalid descriptor.

##### **comparison-result**

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: write only  
 mechanism: by reference

Result of the comparison. The **comparison-result** argument is the address of an unsigned longword that contains the comparison result. If the two node names are equal, 0 is returned. If they are not equal, 1 is returned.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$COMPARE\_NODENAME

**Comparison-result** contains an unusable result when LIB\$COMPARE\_NODENAME returns in error.

#### Description

This routine compares two node names and checks to see if they resolve to the same full name. The two node names are first expanded using LIB\$EXPAND\_NODENAME. Any errors that result from expanding the input node names are propagated and returned as condition values. A string comparison is performed on the expanded node names to check if they resolve to the same full name. The result of the comparison is returned in **comparison-result** as follows:

| comparison-result Value | Meaning                   |
|-------------------------|---------------------------|
| 0                       | Node names are equal.     |
| 1                       | Node names are not equal. |

#### Condition Values Returned

|   |   |
|---|---|
| SS\$_NORMAL   | Routine successfully completed.   |
| LIB\$_INVARG  | Invalid argument: <ul style="list-style-type: none"><li>• <b>nodename1</b> or <b>nodename2</b> is an invalid node name.</li><li>• <b>nodename1</b> or <b>nodename2</b> points to a null string.</li><li>• The length of the node name is more than 1024 characters.</li><li>• The expanded DECnet/OSI node name is invalid in a DECnet Phase IV system.</li></ul> |
| LIB\$_INVSTRDES   | Invalid string descriptor.  |
| LIB\$_WRONUMARG   | Wrong number of arguments.  |
| Any condition value returned by LIB\$SCOPY_R_DX.          |   |
| Any condition value returned by the \$IPC DECnet service. |   |

---

## LIB\$COMPRESS\_NODENAME

### Compress a Node Name to Its Short Form

The Compress a Node Name to Its Short Form Equivalence routine compresses a node name to an unambiguous short form usable within the naming environment where the compression is performed.†

#### Format

LIB\$COMPRESS\_NODENAME nodename ,compressed-nodename [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **nodename**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Node name to be compressed. The **nodename** argument contains the address of a descriptor pointing to this node-name string.

The error LIB\$\_INVARG is returned if **nodename** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if the **nodename** descriptor is invalid.

##### **compressed-nodename**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Compressed node name. The **compressed-nodename** argument contains the address of a descriptor pointing to the compressed node-name string. LIB\$COMPRESS\_NODENAME writes the compressed node name into the buffer pointed to by **compressed-nodename**.

The error LIB\$\_INVSTRDES is returned if **compressed-nodename** is an invalid descriptor.

The length field of the **compressed-nodename** descriptor is not updated unless **compressed-nodename** is a dynamic descriptor with a length less than the resulting compressed node name. Refer to the *OpenVMS RTL String Manipulation (STR\$) Manual* for dynamic string descriptor usage.

The **compressed-nodename** argument contains an unusable result when LIB\$COMPRESS\_NODENAME returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$COMPRESS\_NODENAME

#### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the compressed node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB\$COMPRESS\_NODENAME returns in error.

## Description

This routine compresses a given node name to a short form that is usable within the local naming environment in which the compression is performed. The local naming environment is defined by the underlying network directory services. Be careful when using the compressed node name for making network connections. Using the compressed node name outside the intended local naming environment may result in an ambiguous reference. Use the full name whenever you need to eliminate ambiguity.

The **nodename** argument is validated against the supported form of node names. The error LIB\$\_INVARG is returned if the input node name is invalid.

When calling LIB\$COMPRESS\_NODENAME in a DECnet/OSI environment, the underlying network layer verifies the existence of the input node name. If the input node name does not resolve to an existing node name in the naming environment, an error condition is returned by the underlying network layer and propagated back to the caller of LIB\$COMPRESS\_NODENAME.

If the returned compressed node name overflows the buffer pointed to by **compressed-nodename**, the compressed node name is truncated, and the alternate successful status LIB\$\_STRTRU is returned.

The actual length of the compressed node name written to the output buffer **compressed-nodename** is returned in **resultant-length** if this argument is supplied.

On a DECnet Phase IV system, compressing a DECnet/OSI node name results in the error condition LIB\$\_INVARG.

## Condition Values Returned

|              |  |
|--------------|--|
| SS\$_NORMAL  | Routine successfully completed.  |
| LIB\$_STRTRU | Routine successfully completed. Characters are truncated in the output buffer pointed to by <b>compressed-nodename</b> . |

**LIB\$ Routines**  
**LIB\$COMPRESS\_NODENAME**

**LIB\$\_INVARG**

Invalid argument:

- **nodename** is invalid.
- **nodename** points to a null string.
- The length of the node name is more than 1024 characters.
- The compressed DECnet/OSI node name is invalid in a DECnet Phase IV system.

**LIB\$\_INVSTRDES**

Invalid string descriptor.

**LIB\$\_WRONUMARG**

Wrong number of arguments.

Any condition value returned by LIB\$SCOPY\_R\_DX.

Any condition value returned by the \$IPC DECnet service.

---

## LIB\$CONVERT\_DATE\_STRING

### Convert Date String to Quadword

The Convert Date String to Quadword routine converts an absolute date string into an OpenVMS internal format date-time quadword. That is, given an input date/time string of a specified format, LIB\$CONVERT\_DATE\_STRING converts this string to an OpenVMS internal format time.

#### Format

LIB\$CONVERT\_DATE\_STRING date-string ,date-time [,user-context] [,flags] [,defaults] [,defaulted-fields]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### date-string

OpenVMS usage: time\_name  
type: character-coded text string  
access: read only  
mechanism: by descriptor

Date string that specifies the absolute time to be converted to an internal system time. The **date-string** argument is the address of a descriptor pointing to this date string. This string must have a format corresponding to the currently defined input format, or it must be one of the relative day strings YESTERDAY, TODAY, or TOMORROW, or their equivalents in the currently selected language.

##### date-time

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Receives the converted time. The **date-time** argument is the address of an unsigned quadword that contains this OpenVMS internal format converted time.

##### user-context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context variable that retains the translation context over multiple calls to this routine. The **user-context** argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write directly to the cell.

The **user-context** parameter is optional. However, if a context cell is not passed, the routine LIB\$CONVERT\_DATE\_STRING may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, Digital recommends that users specify a different context cell for each calling thread.

**flags**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Specifies which date or time fields of the **date-string** argument might be omitted so that default values are applied. The **flags** argument is the address of a longword bit mask that contains these flags. A set bit indicates that the field may be omitted. The bit definitions for the mask correspond to the fields in a \$NUMTIM "timbuf" structure as follows:

| Field              | Bit Number | Mask |
|--------------------|------------|------|
| Year               | 0          | 1    |
| Month              | 1          | 2    |
| Day of month       | 2          | 4    |
| Hours              | 3          | 8    |
| Minutes            | 4          | 16   |
| Seconds            | 5          | 32   |
| Fractional seconds | 6          | 64   |

Bits 7 through 31 must be zero and are reserved for use by Digital. If this parameter is omitted, a default value of 120 (78H) is used, indicating that the time fields may be defaulted but the date fields may not.

**defaults**

OpenVMS usage: vector\_word\_unsigned  
 type: word (unsigned)  
 access: read only  
 mechanism: by reference, array reference

Supplies the defaults to be used for omitted fields. The **defaults** argument is the address of an array of unsigned words containing these default values. This array corresponds to a 7-word \$NUMTIM "timbuf" structure. If the **defaults** argument is omitted, the following defaults are applied:

- For the date group, the default is the current date.
- For the time group, the default is 00:00:00.00.

## LIB\$ Routines

### LIB\$CONVERT\_DATE\_STRING

#### defaulted-fields

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Indicates which date or time fields have been defaulted. The **defaulted-fields** argument is the address of a longword bit mask that specifies these fields. The bit definitions are identical to those of the **flags** bit mask. A set bit indicates that the field was defaulted. Bits 7 through 31, which are reserved for use by Digital, are zeroed.

## Description

LIB\$CONVERT\_DATE\_STRING converts an absolute date string into an OpenVMS internal format date-time quadword. The input date string can either correspond to the format specified, or it can be the language equivalent of one of the relative date strings YESTERDAY, TODAY, or TOMORROW. The language to be used and the format in which to interpret the information are programmable using either of the following methods:

- The language and format are programmable at compile time through the use of the routine LIB\$INIT\_DATE\_TIME\_CONTEXT.
- The language and format can be determined at run time through the translation of the logical names SYS\$LANGUAGE and LIB\$DT\_INPUT\_FORMAT.

In general, if an application is reading text from internal storage, the language and input format should be specified at compile time. If this is the case, use the routine LIB\$INIT\_DATE\_TIME\_CONTEXT to specify the language and input format of your choice.

If an application is accepting text from a user, the logical name method of specifying language and format should be used. In this method, the user assigns equivalence names to the logical names SYS\$LANGUAGE and LIB\$DT\_INPUT\_FORMAT, thereby selecting the language and input format of the date and time at run time.

The calling program can choose to apply defaults for omitted fields in the date string. To do this, the **flags** argument is used to indicate which fields are to be defaulted, and the **defaults** argument is used to supply the default values. If the **defaults** argument is not supplied, the following default values are applied:

- For the date group, the default is the current date.
- For the time group, the default is 00:00:00.00.

Optionally, you can use the **defaulted-fields** argument to receive information on which input fields were omitted and thus accepted default values.

---

#### Note

---

Because the default is the current date for the date group, if you specify a value of 00 with the !Y2 format, the year is interpreted as 1900. After January 1, 2000, the value 00 will be interpreted as 2000.

---

## LIB\$ Routines LIB\$CONVERT\_DATE\_STRING

See the *OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

### Condition Values Returned

|                  |   |
|------------------|---|
| SS\$_NORMAL      | Routine successfully completed.                             |
| LIB\$_DEFFORUSE  | Default format used; unable to determine desired format.    |
| LIB\$_ENGLUSED   | English used by default; unable to translate SYS\$LANGUAGE. |
| LIB\$_AMBDATTIM  | Ambiguous date or time.                                     |
| LIB\$_INCDATTIM  | Incomplete date or time; missing fields with no defaults.   |
| LIB\$_ILLFORMAT  | Illegal format string; too many or not enough fields.       |
| LIB\$_INVARG     | Invalid argument; a required argument was not specified.    |
| LIB\$_INVSTRDES  | Invalid input string descriptor.                            |
| LIB\$_IVTIME     | Invalid date or time.                                       |
| LIB\$_REENTRANCY | Reentrancy detected.  |
| LIB\$_UNRFORCOD  | Unrecognized format code.                                   |
| LIB\$_WRONUMARG  | Wrong number of arguments.                                  |

Any condition value returned by LIB\$GET\_VM, LIB\$FREE\_VM, LIB\$FREE1\_DD, LIB\$SCOPY\_R\_DX, SYS\$NUMTIM, and SYS\$GETTIM.

## LIB\$CRC

### Calculate a Cyclic Redundancy Check (CRC)

The Calculate a Cyclic Redundancy Check routine calculates the cyclic redundancy check (CRC) for a data stream.

#### Format

LIB\$CRC *crc-table* ,*initial-crc* ,*stream*

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The computed cyclic redundancy check.

#### Arguments

##### **crc-table**

OpenVMS usage: vector\_longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference, array reference

The 16-longword cyclic redundancy check table created by a call to LIB\$CRC\_TABLE. The **crc-table** argument is the address of a signed longword integer containing this table. Because this table is created by LIB\$CRC\_TABLE and then used as input in LIB\$CRC, your program must call LIB\$CRC\_TABLE before it calls LIB\$CRC.

##### **initial-crc**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Initial cyclic redundancy check. The **initial-crc** argument is the address of a signed longword integer containing the initial cyclic redundancy check.

##### **stream**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Data stream for which LIB\$CRC is calculating the CRC. The **stream** argument is the address of a descriptor pointing to the data stream.

## **Description**

Before your program can call LIB\$CRC, it must call LIB\$CRC\_TABLE. LIB\$CRC\_TABLE takes a polynomial as its input and builds the table that LIB\$CRC uses to calculate the CRC.

LIB\$CRC allows your high-level language program to use the CRC instruction, which calculates the cyclic redundancy check.<sup>1</sup> This instruction checks the integrity of a data stream by comparing its state at the sending point and the receiving point. Each character in the data stream is used to generate a value based on a polynomial. The values for each character are then added together. This operation is performed at both ends of the data transmission, and the two result values compared. If the results disagree, then an error occurred during the transmission.

## **Condition Values Returned**

None.

## **Example**

For an example on how to use LIB\$CRC, refer to the BASIC example at the end of the description of LIB\$CRC\_TABLE.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

---

## LIB\$CRC\_TABLE

### Construct a Cyclic Redundancy Check (CRC) Table

The Construct a Cyclic Redundancy Check Table routine constructs a 16-longword table that uses a cyclic redundancy check polynomial specification as a bit mask.

#### Format

LIB\$CRC\_TABLE polynomial-coefficient ,crc-table

#### Returns

None.

#### Arguments

##### polynomial-coefficient

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

A bit mask indicating which polynomial coefficients are to be generated by LIB\$CRC\_TABLE. The **polynomial-coefficient** argument is the address of an unsigned longword integer containing this bit mask.

##### crc-table

OpenVMS usage: vector\_longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference, array reference

The 16-longword table that LIB\$CRC\_TABLE produces. The **crc-table** argument is the address of a signed longword integer containing the table.

#### Description

The table created by LIB\$CRC\_TABLE can be passed to the LIB\$CRC routine for generating the cyclic redundancy check value for a stream of characters.

#### Condition Values Returned

None.

#### Example

```
1  %TITLE "Demonstrate LIB$CRC and LIB$CRC_TABLE"
   %SBTTL "Declarations"
   %IDENT "1-001"

   !--
   OPTION TYPE = EXPLICIT

   DECLARE LONG      CRC_TABLE(15),      ! CRC table array &
      LONG           CRC_VAL_1,         ! CRC for first stream &
      LONG           CRC_VAL_2,         ! CRC for second stream &
      STRING         DATA_1,           ! First data stream &
      STRING         DATA_2            ! Second data stream
```

## LIB\$ Routines LIB\$CRC\_TABLE

```

EXTERNAL LONG FUNCTION LIB$CRC           ! Rtn to calculate CRC
EXTERNAL SUB LIB$CRC_TABLE              ! Rtn to set up table for CRC

OPEN "SYS$INPUT:" FOR INPUT AS FILE 1%

!+
! Initialize the CRC table. Use the CRC-16 polynomial (refer to the
! "VAX Architecture Reference Manual"). This is the polynomial used by
! DDCMP and Bisync.
!-

CALL LIB$CRC_TABLE( 0'120001'L, CRC_TABLE() BY REF )

!+
! Get data from user.
!-

LINPUT #1%, 'Enter string: ';DATA_1

!+
! Calc the CRC for the user's input. This CRC polynomial needs
! an initial CRC of 0 (refer to the "VAX Architecture Reference Manual").
! LIB$CRC returns a longword, but only the low-order word is valid
! for this polynomial.
!-

CRC_VAL_1 = LIB$CRC( CRC_TABLE() BY REF, 0%, DATA_1 )
CRC_VAL_1 = CRC_VAL_1 AND 32767%

!+
! Get more data from user.
!-

LINPUT #1%, 'Enter a second string: ';DATA_2

CRC_VAL_2 = LIB$CRC( CRC_TABLE() BY REF, 0%, DATA_2 )
CRC_VAL_2 = CRC_VAL_2 AND 32767%

!+
! Tell the user the results of the CRC comparison.
!-

IF CRC_VAL_1 = CRC_VAL_2
THEN
    PRINT "The two CRCs";CRC_VAL_1;" and ";CRC_VAL_2;" were the same"
ELSE
    PRINT "The two CRCs";CRC_VAL_1;" and ";CRC_VAL_2;" were different"
END IF

IF DATA_1 = DATA_2
THEN
    PRINT "The two strings were the same"
ELSE
    PRINT "The two strings were different"
END IF

END

```

This BASIC example program shows the use of LIB\$CRC and LIB\$CRC\_TABLE. One example of the output generated by this program is as follows:

```

$ RUN CRC
Enter string: DOVE
Enter a second string: HOSE
The two CRCs 29915 and 29915 were the same
The two strings were different

```

---

## LIB\$CREATE\_DIR

### Create a Directory

The Create a Directory routine creates a directory or subdirectory.

#### Format

```
LIB$CREATE_DIR device-directory-spec [,owner-UIC] [,protection-enable] [,protection-value]
               [,maximum-versions] [,relative-volume-number] [,initial-allocation]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### device-directory-spec

OpenVMS usage: device\_name  
type: character string  
access: read only  
mechanism: by descriptor

Directory specification of the directory or subdirectory that LIB\$CREATE\_DIR will create. The **device-directory-spec** argument is the address of a descriptor pointing to this directory specification.

The format of the **device-directory-spec** string conforms to standard OpenVMS Record Management Services (RMS) format. This specification must contain a directory or subdirectory specification. It may contain a disk specification. SMD\$:[THIS.IS.IT] is an example of a standard RMS file specification, where SMD\$ is the disk specification and [THIS.IS.IT] is the subdirectory specification.

This specification cannot contain a node name, file name, file type, file version, or wildcard characters. The maximum size of this string is 255 characters.

##### owner-UIC

OpenVMS usage: uic  
type: longword (unsigned)  
access: read only  
mechanism: by reference

User Identification Code (UIC) identifying the owner of the created directory or subdirectory. The **owner-UIC** argument is the address of an unsigned longword that contains the UIC. If **owner-UIC** is zero, the owner UIC is that of the parent directory. The specified value for **owner-UIC** is interpreted as a 32-bit octal number, with two 16-bit fields:

bits 00–15 — Member number  
bits 16–31 — Group number

This is an optional argument. The default is the UIC of the current process except when the directory is in UIC format. For a directory in UIC format, for example [123,321], the UIC of the created directory is used.

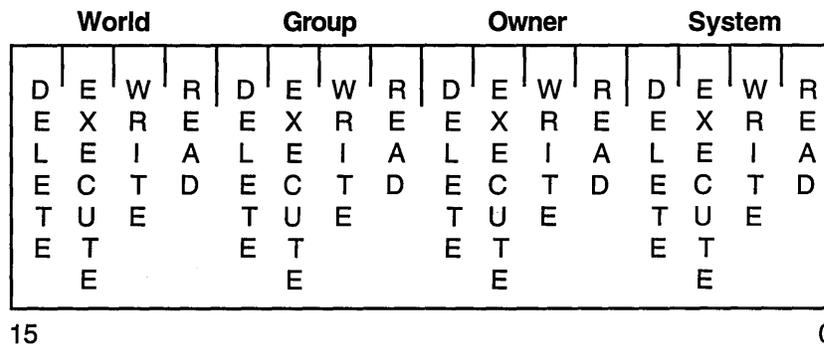
**protection-enable**

OpenVMS usage: mask\_word  
 type: word (unsigned)  
 access: read only  
 mechanism: by reference

Mask specifying the bits of **protection-value** to be set. The **protection-enable** argument is the address of an unsigned word containing this protection mask.

Figure LIB-1 shows the structure of a protection mask. Access is allowed for bits set to zero.

Figure LIB-1 Structure of a Protection Mask



ZK-1979-GE

Set bits in the **protection-enable** mask cause corresponding bits of **protection-value** to be set. Clear bits in the **protection-enable** mask cause corresponding bits of **protection-value** to take the value of the corresponding bit in the parent directory's file protection. Bits in the parent directory's file protection that indicate delete access do not cause corresponding bits of **protection-value** to be set, however.

Following is an example of how the **protection-value** protection mask is defined:

| Mask Name         | Hexadecimal Number | Value                     |
|-------------------|--------------------|---------------------------|
| Protection enable | %XDBFF             | S:None, O:None, G:E, W:W  |
| Parent directory  | %X13FF             | S:RWED, O:RWED, G:RW, W:R |
| Protection value  | %X37FF             | S:RWE, O:RWE, G:RWE, W:RW |

The **protection-enable** argument is optional. It should be used only when you want to change protection values from the parent directory's default file protection. The default for **protection-enable** is a mask of all zero bits, which results in the propagation of the parent directory's file protection. If the **protection-enable** mask contains zeros, **protection-value** is ignored.

## LIB\$ Routines

### LIB\$CREATE\_DIR

#### **protection-value**

OpenVMS usage: file\_protection  
type: word (unsigned)  
access: read only  
mechanism: by reference

System/Owner/Group/World protection value of the directory you are creating. The **protection-value** argument is the address of an unsigned word which contains this protection mask.

The bits of **protection-value** are set or cleared in the method described in the definition of **protection-enable** above.

The **protection-value** argument is optional. The default is a word of all zero bits, which specifies full access for all access categories. Typically, **protection-value** is not omitted unless **protection-enable** is also omitted. If **protection-enable** is omitted, **protection-value** is ignored.

#### **maximum-versions**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Maximum number of versions allowed for files created in the newly created directories. The **maximum-versions** argument is the address of an unsigned word containing the value of the maximum number of versions.

The **maximum-versions** argument is optional. The default is the parent directory's default version limit. If **maximum-versions** is zero, the maximum number of versions is not limited.

#### **relative-volume-number**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Relative volume number within a volume set on which the directory or subdirectory is created. The **relative-volume-number** argument is the address of an unsigned word containing the relative volume number. The **relative-volume-number** argument is optional. The default is arbitrary placement within the volume set.

#### **initial-allocation**

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Initial number of blocks to be allocated to the directory. This argument is useful for creating large directories, for example MAIL.DIR;1. It can improve performance by avoiding the need for later dynamic expansion of the directory.

The **initial-allocation** argument applies only to Files-11 Level 2 volumes; it is ignored for other volumes.

This argument is the address of an unsigned longword that contains the initial number of blocks to be allocated to the directory.

The **initial-allocation** argument is optional. The default allocation is 1 block.

## Description

LIB\$CREATE\_DIR creates a directory. You can specify:

- The owner and protection of the directory.
- The maximum number of different versions of a file that can exist in the directory.
- The relative volume number of the volume set member in which the directory is to be created.
- The number of blocks to be allocated initially to the directory.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_CREATED    | Routine successfully completed; one or more directories created.   |
| SS\$_NORMAL     | Routine successfully completed; all specified directories already exist.   |
| LIB\$_INVARG    | Invalid argument to Run-Time Library. Either the required argument was omitted, or <b>device-directory-spec</b> is longer than 255 characters.   |
| LIB\$_INVFILSPE | Invalid file specification. Either the file specification did not contain an explicit directory and device name, or it contained a node name, file name, file type, file version, or wildcard. This error is also produced if the device specified was not a disk. |

Any condition values returned by \$ASSIGN.

Any condition values returned by \$DASSGN.

Any condition values returned by \$PARSE.

Any condition values returned by \$QIO.

Any condition values returned by LIB\$ANALYZE\_SDESC or LIB\$ANALYZE\_SDESC\_64.

Any condition values returned by LIB\$GET\_EF.

## LIB\$ Routines

### LIB\$CREATE\_USER\_VM\_ZONE

---

## LIB\$CREATE\_USER\_VM\_ZONE

### Create User-Defined Storage Zone

The Create User-Defined Storage Zone routine creates a new user-defined storage zone in the 32-bit virtual address space.†

#### Format

```
LIB$CREATE_USER_VM_ZONE zone-id [,user-argument] [,user-allocation-procedure]
                        [,user-deallocation-procedure] [,user-reset-procedure]
                        [,user-delete-procedure] [,zone-name]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### zone-id

OpenVMS usage: identifier  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Zone identifier. The **zone-id** argument is the address of a longword that receives the identifier of the newly created zone.

##### user-argument

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

User argument. The **user-argument** argument is the address of an unsigned longword containing the user argument. LIB\$CREATE\_USER\_VM\_ZONE copies the value of **user-argument** and supplies the value to all user procedures invoked.

##### user-allocation-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User allocation routine.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

**user-deallocation-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User deallocation routine.

**user-reset-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User routine invoked each time LIB\$RESET\_VM\_ZONE is called for the zone.

**user-delete-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User routine invoked when LIB\$DELETE\_VM\_ZONE is called for the zone.

**zone-name**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

## Description

LIB\$CREATE\_USER\_VM\_ZONE creates a user-defined zone in the 32-bit virtual address space. If an error status is returned, the zone is not created.

Each time that one of the heap management routines (LIB\$GET\_VM, LIB\$FREE\_VM, LIB\$RESET\_VM\_ZONE, or LIB\$DELETE\_VM\_ZONE) is called to perform an operation on a user-defined zone, the corresponding user routine that you supplied is used.

You may omit any of the optional user routines. However, if you omit a routine and later call the corresponding heap management routine, the error status LIB\$\_INVOPEZON will be returned.

## LIB\$ Routines

### LIB\$CREATE\_USER\_VM\_ZONE

#### Call Format for User Routines

The user routines are called with arguments similar to those passed to LIB\$GET\_VM, LIB\$FREE\_VM, LIB\$RESET\_VM\_ZONE, or LIB\$DELETE\_VM\_ZONE. In each case, the **user-argument** argument from LIB\$CREATE\_USER\_VM\_ZONE is passed to the user routine rather than a **zone-id** argument.

The call format for a user get or free routine is as follows:

**user-rtn** num-bytes ,base-adr ,user-argument

#### num-bytes

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of contiguous bytes to allocate or free. The **num-bytes** argument is the address of a longword integer containing the number of bytes. The value of **num-bytes** must be greater than zero.

#### base-adr

OpenVMS usage: address  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Virtual address of the first contiguous block of bytes allocated or freed. The **base-adr** argument is the address of an unsigned longword containing this base address. (This argument is write-only for a get routine and read-only for a free routine.)

#### user-argument

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

User argument. LIB\$CREATE\_USER\_VM\_ZONE copies **user-argument** as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB\$GET\_VM or LIB\$FREE\_VM.

The **zone-id** value that is returned can be used in calls to LIB\$SHOW\_VM\_ZONE and LIB\$VERIFY\_VM\_ZONE.

The call format for a user reset or delete routine is as follows:

**user-rtn** user-argument

#### user-argument

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

User argument. LIB\$CREATE\_USER\_VM\_ZONE copies **user-argument** as it is supplied to all user routines invoked.

**LIB\$ Routines**  
**LIB\$CREATE\_USER\_VM\_ZONE**

The status value returned by your routine is returned as the status value for the corresponding call to LIB\$RESET\_VM\_ZONE or LIB\$DELETE\_VM\_ZONE.

**Condition Values Returned**

|                  |  |
|------------------|--|
| SS\$ _NORMAL     | Routine successfully completed.                  |
| LIB\$ _INSVIRMEM | Insufficient virtual memory.                     |
| LIB\$ _INVSTRDES | Invalid string descriptor for <b>zone-name</b> . |

## LIB\$ Routines

### LIB\$CREATE\_USER\_VM\_ZONE\_64 (Alpha Only)

---

## LIB\$CREATE\_USER\_VM\_ZONE\_64 (Alpha Only)

### Create User-Defined Storage Zone

The Create User-Defined Storage Zone routine creates a new user-defined storage zone in the 64-bit virtual address space.

#### Format

```
LIB$CREATE_USER_VM_ZONE_64 zone-id [,user-argument] [,user-allocation-procedure]
                             [,user-deallocation-procedure] [,user-reset-procedure]
                             [,user-delete-procedure] [,zone-name]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### zone-id

OpenVMS usage: identifier  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Zone identifier. The **zone-id** argument is the address of a quadword that receives the identifier of the newly created zone.

##### user-argument

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

User argument. The **user-argument** argument is the address of an unsigned quadword containing the user argument. LIB\$CREATE\_USER\_VM\_ZONE\_64 copies the value of **user-argument** and supplies the value to all user procedures invoked.

##### user-allocation-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User allocation routine.

##### user-deallocation-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User deallocation routine.

## LIB\$ Routines LIB\$CREATE\_USER\_VM\_ZONE\_64 (Alpha Only)

### user-reset-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User routine invoked each time LIB\$RESET\_VM\_ZONE\_64 is called for the zone.

### user-delete-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User routine invoked when LIB\$DELETE\_VM\_ZONE\_64 is called for the zone.

### zone-name

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

## Description

LIB\$CREATE\_USER\_VM\_ZONE\_64 creates a user-defined zone in the 64-bit virtual address space. If an error status is returned, the zone is not created.

Each time that one of the heap management routines (LIB\$GET\_VM\_64, LIB\$FREE\_VM\_64, LIB\$RESET\_VM\_ZONE\_64, or LIB\$DELETE\_VM\_ZONE\_64) is called to perform an operation on a user-defined zone, the corresponding user routine that you supplied is used.

You may omit any of the optional user routines. However, if you omit a routine and later call the corresponding heap management routine, the error status LIB\$\_INVOPEZON will be returned.

### Call Format for User Routines

The user routines are called with arguments similar to those passed to LIB\$GET\_VM\_64, LIB\$FREE\_VM\_64, LIB\$RESET\_VM\_ZONE\_64, or LIB\$DELETE\_VM\_ZONE\_64. In each case, the **user-argument** argument from LIB\$CREATE\_USER\_VM\_ZONE\_64 is passed to the user routine rather than a **zone-id** argument.

The call format for a user get or free routine is as follows:

**user-rtn** num-bytes ,base-adr ,user-argument

### num-bytes

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

## LIB\$ Routines

### LIB\$CREATE\_USER\_VM\_ZONE\_64 (Alpha Only)

Number of contiguous bytes to allocate or free. The **num-bytes** argument is the address of a quadword integer containing the number of bytes. The value of **num-bytes** must be greater than zero.

#### **base-adr**

OpenVMS usage: address  
type: quadword (unsigned)  
access: modify  
mechanism: by reference

Virtual address of the first contiguous block of bytes allocated or freed. The **base-adr** argument is the address of an unsigned quadword containing this base address. (This argument is write-only for a get routine and read-only for a free routine.)

#### **user-argument**

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

User argument. LIB\$CREATE\_USER\_VM\_ZONE\_64 copies **user-argument** as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB\$GET\_VM\_64 or LIB\$FREE\_VM\_64.

The **zone-id** value that is returned can be used in calls to LIB\$SHOW\_VM\_ZONE\_64 and LIB\$VERIFY\_VM\_ZONE\_64.

The call format for a user reset or delete routine is as follows:

**user-rtn** user-argument

#### **user-argument**

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

User argument. LIB\$CREATE\_USER\_VM\_ZONE\_64 copies **user-argument** as it is supplied to all user routines invoked.

The status value returned by your routine is returned as the status value for the corresponding call to LIB\$RESET\_VM\_ZONE\_64 or LIB\$DELETE\_VM\_ZONE\_64.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.                  |
| LIB\$_INSVIRMEM | Insufficient virtual memory.                     |
| LIB\$_INVSTRDES | Invalid string descriptor for <b>zone-name</b> . |

---

## LIB\$CREATE\_VM\_ZONE

### Create a New Zone

The Create a New Zone routine creates a new storage zone in the 32-bit virtual address space, according to specified arguments.†

#### Format

```
LIB$CREATE_VM_ZONE zone-id [,algorithm] [,algorithm-argument] [,flags] [,extend-size] [,initial-size]
                    [,block-size] [,alignment] [,page-limit] [,smallest-block-size] [,zone-name]
                    [,get-page] [,free-page]
```

#### Returns

```
OpenVMS usage: cond_value
type:         longword (unsigned)
access:       write only
mechanism:    by value
```

#### Arguments

##### zone-id

```
OpenVMS usage: identifier
type:         longword (unsigned)
access:       write only
mechanism:    by reference
```

Zone identifier. The **zone-id** argument is the address of a longword that is set to the zone identifier of the newly created zone.

##### algorithm

```
OpenVMS usage: longword_signed
type:         longword integer (signed)
access:       read only
mechanism:    by reference
```

Algorithm. The **algorithm** argument is the address of a longword integer that contains a value representing one of the LIB\$VM algorithms. Use one of the predefined symbols to specify this value.

| Symbol               | Value | Algorithm                      |
|----------------------|-------|--------------------------------|
| LIB\$K_VM_FIRST_FIT  | 1     | First fit                      |
| LIB\$K_VM_QUICK_FIT  | 2     | Quick fit, lookaside list      |
| LIB\$K_VM_FREQ_SIZES | 3     | Frequent sizes, lookaside list |
| LIB\$K_VM_FIXED      | 4     | Fixed size blocks              |

If **algorithm** is not specified, a default of 1 (first fit) is used.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$CREATE\_VM\_ZONE

#### algorithm-argument

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Algorithm argument. The **algorithm-argument** argument is the address of a longword integer that contains a value specific to the particular allocation algorithm as shown in the following table.

| Algorithm         | Value  |
|-------------------|--|
| First fit         | Not used, may be omitted.  |
| Quick fit         | The number of lookaside lists used. The number of lists must be between 1 and 128.                       |
| Frequent sizes    | The number of lookaside lists used. The number of lists must be between 1 and 16.                        |
| Fixed size blocks | The fixed request size (in bytes) for each get or free request. The request size must be greater than 0. |

The **algorithm-argument** argument must be specified if you are using the quick-fit, frequent-sizes or fixed-size-blocks algorithms. However, this argument is optional, but ignored, if you are using the first-fit algorithm.

#### flags

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Flags. The **flags** argument is the address of a longword integer that contains flag bits that control various options, as follows:

| Bit | Value                   | Description  |
|-----|-------------------------|--|
| 0   | LIB\$M_VM_BOUNDARY_TAGS | Boundary tags for faster freeing. Adds a minimum of 8 bytes to each block. |
| 1   | LIB\$M_VM_GET_FILL0     | LIB\$GET_VM; fill with bytes of 0.   |
| 2   | LIB\$M_VM_GET_FILL1     | LIB\$GET_VM; fill with bytes of FF (hexadecimal).                          |
| 3   | LIB\$M_VM_FREE_FILL0    | LIB\$FREE_VM; fill with bytes of 0.  |
| 4   | LIB\$M_VM_FREE_FILL1    | LIB\$FREE_VM; fill with bytes of FF (hexadecimal).                         |
| 5   | LIB\$M_VM_EXTEND_AREA   | Adds extents to existing areas if possible.                                |

| Bit | Value                | Description  |
|-----|----------------------|--|
| 6   | LIB\$M_VM_NO_EXTEND  | Prevents zone from being extended beyond its initial size. If you specify this flag, you must also specify an <b>initial-size</b> . The <b>extend-size</b> argument is not used.   |
| 7   | LIB\$M_VM_TAIL_LARGE | Adds areas larger than <b>extend-size</b> areas to the end of the area list. Allocations that are larger than <b>extend-size</b> can result in new areas. These areas are added to the end of the area list. (This provides better memory reuse when allocating small and very large blocks from the same zone.) |

Bits 8 through 31 are reserved and must be 0.

This is an optional argument. If **flags** is omitted, the default of 0 (no fill and no boundary tags) is used.

**extend-size**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Zone extend size. The **extend-size** argument is the address of a longword integer that contains the number of (512-byte) pages on VAX systems or pagelets on Alpha systems to be added to the zone each time it is extended.

The value of **extend-size** must be greater than or equal to 1.

This is an optional argument. If **extend-size** is not specified, a default of 16 pages on VAX systems or pagelets on Alpha systems is used.

---

**Note**

---

The **extend-size** argument does not limit the number of blocks that can be allocated from the zone. The actual extension size is the greater of **extend-size** and the number of pages on VAX systems or pagelets on Alpha systems needed to satisfy the LIB\$GET\_VM call that caused the extension.

---

**initial-size**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Initial size for the zone. The **initial-size** argument is the address of a longword integer that contains the number of (512-byte) pages on VAX systems or pagelets on Alpha systems to be allocated for the zone as the zone is created.

## LIB\$ Routines

### LIB\$CREATE\_VM\_ZONE

This is an optional argument. If you specify a value for **initial-size**, the value must be greater than or equal to 0; otherwise, LIB\$\_INVARG is returned. If **initial-size** is not specified or is specified as 0, no pages on VAX systems or pagelets on Alpha systems are allocated when the zone is created. The first call to LIB\$GET\_VM for the zone allocates **extend-size** pages on VAX systems or pagelets on Alpha systems.

#### **block-size**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Block size of the zone. The **block-size** argument is the address of a longword integer specifying the allocation quantum (in bytes) for the zone. All blocks allocated are rounded up to a multiple of **block-size**.

The value of **block-size** must be a power of 2 between 8 and 512. This is an optional argument. If **block-size** is not specified, a default of 8 is used.

#### **alignment**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Block alignment. The **alignment** argument is the address of a longword integer that specifies the required address alignment (in bytes) for each block allocated.

The value of **alignment** must be a power of 2 between 4 and 512. This is an optional argument. If **alignment** is not specified, a default of 8 (quadword alignment) is used.

#### **page-limit**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Maximum page limit. The **page-limit** argument is the address of a longword integer that specifies the maximum number of (512-byte) pages on VAX systems or pagelets on Alpha systems that can be allocated for the zone. The value of **page-limit** must be greater than or equal to 0. Note that part of the zone is used for header information.

This is an optional argument. If **page-limit** is not specified or is specified as 0, the only limit is the total process virtual address space limit imposed by OpenVMS. If **page-limit** is specified, then **initial-size** must also be specified.

#### **smallest-block-size**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Smallest block size. The **smallest-block-size** argument is the address of a longword integer that specifies the smallest block size (in bytes) that has a lookaside list for the quick fit algorithm.

If **smallest-block-size** is not specified, the default of **block-size** is used. That is, lookaside lists are provided for the first *n* multiples of **block-size**.

**zone-name**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

**get-page**

OpenVMS usage: procedure  
type: procedure value  
access: read only  
mechanism: by value

Routine that allocates memory. The number and type of the arguments to this routine must match those of the LIB\$GET\_VM\_PAGE routine. If **get-page** is not specified or is specified as 0, the LIB\$GET\_VM\_PAGE routine is used to allocate memory.

**free-page**

OpenVMS usage: procedure  
type: procedure value  
access: read only  
mechanism: by value

Routine that deallocates memory. The number and type of the arguments to this routine must match those of the LIB\$FREE\_VM\_PAGE routine. If **free-page** is not specified or if **free-page** is specified as 0, the LIB\$FREE\_VM\_PAGE routine is used to deallocate memory.

## Description

LIB\$CREATE\_VM\_ZONE creates a new storage zone. The zone identifier value that is returned can be used in calls to LIB\$GET\_VM, LIB\$FREE\_VM, LIB\$RESET\_VM\_ZONE, LIB\$DELETE\_VM\_ZONE, LIB\$SHOW\_VM\_ZONE, LIB\$VERIFY\_VM\_ZONE, and LIB\$CREATE\_USER\_VM\_ZONE.

The following restrictions apply when you are creating a zone:

- If you want the zone to be accessible from another process or processes, you must map the global section into the same virtual addresses in all processes. You can use PPL\$CREATE\_SHARED\_MEM to map to a global section after you have first called PPL\$INITIALIZE.
- The zone cannot expand; in other words, additional areas cannot be added to the zone.
- The restrictions for LIB\$RESET\_VM\_ZONE also apply to shared zones. That is, it is the caller's responsibility to ensure that the caller has exclusive access to the zone while the reset operation is being performed.

If an error status is returned, the zone is not created.

**LIB\$ Routines**  
**LIB\$CREATE\_VM\_ZONE**

**Condition Values Returned**

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.                  |
| LIB\$_INSVIRMEM | Insufficient virtual memory.                     |
| LIB\$_INVARG    | Invalid argument.                                |
| LIB\$_INVSTRDES | Invalid string descriptor for <b>zone-name</b> . |

## LIB\$CREATE\_VM\_ZONE\_64 (Alpha Only)

### Create a New Zone

The Create a New Zone routine creates a new storage zone in the 64-bit virtual address space, according to specified arguments.

#### Format

```
LIB$CREATE_VM_ZONE_64 zone-id [,algorithm] [,algorithm-argument] [,flags] [,extend-size] [,initial-size]
                        [,block-size] [,alignment] [,page-limit] [,smallest-block-size] [,zone-name]
                        [,get-page] [,free-page]
```

#### Returns

```
OpenVMS usage: cond_value
type:         longword (unsigned)
access:       write only
mechanism:    by value
```

#### Arguments

##### zone-id

```
OpenVMS usage: identifier
type:         quadword (unsigned)
access:       write only
mechanism:    by reference
```

Zone identifier. The **zone-id** argument is the address of a quadword that is set to the zone identifier of the newly created zone.

##### algorithm

```
OpenVMS usage: quadword_signed
type:         quadword integer (signed)
access:       read only
mechanism:    by reference
```

Algorithm. The **algorithm** argument is the address of a quadword integer that represents the code for one of the LIB\$VM algorithms. Use one of the following predefined symbols to specify this value:

| Symbol               | Value | Algorithm                      |
|----------------------|-------|--------------------------------|
| LIB\$K_VM_FIRST_FIT  | 1     | First fit                      |
| LIB\$K_VM_QUICK_FIT  | 2     | Quick fit, lookaside list      |
| LIB\$K_VM_FREQ_SIZES | 3     | Frequent sizes, lookaside list |
| LIB\$K_VM_FIXED      | 4     | Fixed-size blocks              |

If **algorithm** is not specified, a default of 1 (first fit) is used.

## LIB\$ Routines

### LIB\$CREATE\_VM\_ZONE\_64 (Alpha Only)

#### algorithm-argument

OpenVMS usage: quadword\_signed  
 type: quadword integer (signed)  
 access: read only  
 mechanism: by reference

Algorithm argument. The **algorithm-argument** argument is the address of a quadword integer that contains a value specific to the particular allocation algorithm.

| Algorithm         | Value  |
|-------------------|--|
| First fit         | Not used, may be omitted.  |
| Quick fit         | The number of lookaside lists used. The number of lists must be between 1 and 128.                       |
| Frequent sizes    | The number of lookaside lists used. The number of lists must be between 1 and 16.                        |
| Fixed size blocks | The fixed request size (in bytes) for each get or free request. The request size must be greater than 0. |

The **algorithm-argument** argument must be specified if you are using the quick-fit, frequent-sizes or fixed-size-blocks algorithms. However, this argument is optional, but ignored, if you are using the first-fit algorithm.

#### flags

OpenVMS usage: mask\_quadword  
 type: quadword (unsigned)  
 access: read only  
 mechanism: by reference

Flags. The **flags** argument is the address of a quadword integer that contains flag bits that control various options, as follows:

| Bit | Value                   | Description   |
|-----|-------------------------|---|
| 0   | LIB\$M_VM_BOUNDARY_TAGS | Boundary tags for faster freeing. Adds a minimum of 16 bytes to each block. |
| 1   | LIB\$M_VM_GET_FILL0     | LIB\$GET_VM_64; fill with bytes of 0.                                       |
| 2   | LIB\$M_VM_GET_FILL1     | LIB\$GET_VM_64; fill with bytes of FF (hexadecimal).                        |
| 3   | LIB\$M_VM_FREE_FILL0    | LIB\$FREE_VM_64; fill with bytes of 0.                                      |
| 4   | LIB\$M_VM_FREE_FILL1    | LIB\$FREE_VM_64; fill with bytes of FF (hexadecimal).                       |
| 5   | LIB\$M_VM_EXTEND_AREA   | Adds extents to existing areas if possible.                                 |

**LIB\$ Routines**  
**LIB\$CREATE\_VM\_ZONE\_64 (Alpha Only)**

| Bit | Value                | Description   |
|-----|----------------------|---|
| 6   | LIB\$M_VM_NO_EXTEND  | Prevents zone from being extended beyond its initial size. If you specify this flag, you must also specify an <b>initial-size</b> . <b>Extend-size</b> is not used.   |
| 7   | LIB\$M_VM_TAIL_LARGE | Adds areas larger than <b>extend-size</b> areas to the end of the area list. Allocations that are larger than <b>extend-size</b> can result in new areas. These areas are added to the end of the area list. (This provides better memory re-use when allocating small and very large blocks from the same zone.) |

Bits 8 through 63 are reserved and must be 0.

This is an optional argument. If **flags** is omitted, the default of 0 (no fill and no boundary tags) is used.

**extend-size**

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Zone extend size. The **extend-size** argument is the address of a quadword integer that contains the number of Alpha pagelets to be added to the zone each time it is extended.

The value of **extend-size** must be greater than or equal to 1.

This is an optional argument. If **extend-size** is not specified, a default of 16 Alpha pagelets is used.

**Note**

The **extend-size** argument does not limit the number of blocks that can be allocated from the zone. The actual extension size is the greater of **extend-size** and the number of Alpha pagelets needed to satisfy the LIB\$GET\_VM\_64 call that caused the extension.

**initial-size**

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Initial size for the zone. The **initial-size** argument is the address of a quadword integer that contains the number of Alpha pagelets to be allocated for the zone as the zone is created.

## LIB\$ Routines

### LIB\$CREATE\_VM\_ZONE\_64 (Alpha Only)

This is an optional argument. If you specify a value for **initial-size**, the value must be greater than or equal to 0; otherwise, LIB\$\_INVARG is returned. If **initial-size** is not specified or is specified as 0, no Alpha pagelets are allocated when the zone is created. The first call to LIB\$GET\_VM\_64 for the zone allocates **extend-size** pagelets on Alpha systems.

#### **block-size**

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Block size of the zone. The **block-size** argument is the address of a quadword integer specifying the allocation quantum (in bytes) for the zone. All blocks allocated are rounded up to a multiple of **block-size**.

The value of **block-size** must be a power of 2 between 16 and 512. This is an optional argument. If **block-size** is not specified, a default of 16 is used.

#### **alignment**

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Block alignment. The **alignment** argument is the address of a quadword integer that specifies the required address alignment (in bytes) for each block allocated.

The value of **alignment** must be a power of 2 between 8 and 512. This is an optional argument. If **alignment** is not specified, a default of 16 (octaword alignment) is used.

#### **page-limit**

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Maximum page limit. The **page-limit** argument is the address of a quadword integer that specifies the maximum number of Alpha pagelets that can be allocated for the zone. The value of **page-limit** must be greater than or equal to 0. Note that part of the zone is used for header information.

This is an optional argument. If **page-limit** is not specified or is specified as 0, the only limit is the total process virtual address space limit imposed by OpenVMS. If **page-limit** is specified, then **initial-size** must also be specified.

#### **smallest-block-size**

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Smallest block size. The **smallest-block-size** argument is the address of a quadword integer that specifies the smallest block size (in bytes) that has a lookaside list for the quick fit algorithm.

If **smallest-block-size** is not specified, the default of **block-size** is used. That is, lookaside lists are provided for the first  $n$  multiples of **block-size**.

## LIB\$ Routines LIB\$CREATE\_VM\_ZONE\_64 (Alpha Only)

### zone-name

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name to be associated with the zone being created. The optional **zone-name** argument is the address of a descriptor pointing to the zone name. If **zone-name** is not specified, the zone will not have an associated name.

### get-page

OpenVMS usage: procedure  
type: procedure value  
access: read only  
mechanism: by value

Routine that allocates memory. The number and type of the arguments to this routine must match those of the LIB\$GET\_VM\_PAGE\_64 routine. If **get-page** is not specified or is specified as 0, the LIB\$GET\_VM\_PAGE\_64 routine is used to allocate memory.

### free-page

OpenVMS usage: procedure  
type: procedure value  
access: read only  
mechanism: by value

Routine that deallocates memory. The number and type of the arguments to this routine must match those of the LIB\$FREE\_VM\_PAGE\_64 routine. If **free-page** is not specified or if **free-page** is specified as 0, the LIB\$FREE\_VM\_PAGE\_64 routine is used to deallocate memory.

## Description

LIB\$CREATE\_VM\_ZONE\_64 creates a new storage zone. The zone identifier value that is returned can be used in calls to LIB\$GET\_VM\_ZONE\_64, LIB\$FREE\_VM\_ZONE\_64, LIB\$RESET\_VM\_ZONE\_64, LIB\$DELETE\_VM\_ZONE\_64, LIB\$SHOW\_VM\_ZONE\_64, LIB\$VERIFY\_VM\_ZONE\_64, and LIB\$CREATE\_USER\_VM\_ZONE\_64.

The following restrictions apply when you are creating a zone:

- If you want the zone to be accessible from another process or processes, you must map the global section into the same virtual addresses in all processes.
- The zone cannot expand; in other words, additional areas cannot be added to the zone.
- The restrictions for LIB\$RESET\_VM\_ZONE\_64 also apply to shared zones. That is, it is the caller's responsibility to ensure that the caller has exclusive access to the zone while the reset operation is being performed.

If an error status is returned, the zone is not created.

**LIB\$ Routines**  
**LIB\$CREATE\_VM\_ZONE\_64 (Alpha Only)**

**Condition Values Returned**

|                  |  |
|------------------|--|
| SS\$ _NORMAL     | Routine successfully completed.                  |
| LIB\$ _INSVIRMEM | Insufficient virtual memory.                     |
| LIB\$ _INVARG    | Invalid argument.                                |
| LIB\$ _INVSTRDES | Invalid string descriptor for <b>zone-name</b> . |

---

## LIB\$CRF\_INS\_KEY

### Insert Key in Cross-Reference Table

The Insert Key in Cross-Reference Table routine inserts information about a key into a cross-reference table.†

#### Format

LIB\$CRF\_INS\_KEY control-table ,key-string ,symbol-value ,flags

#### Returns

None.

#### Arguments

##### control-table

OpenVMS usage: vector\_longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference, array reference

Cross-reference table into which LIB\$CRF\_INS\_KEY inserts information about the key. The **control-table** argument is the address of a signed longword integer pointing to the cross-reference table. You must name this table each time you call a cross-reference routine because you can accumulate information for more than one cross-reference table at a time.

##### key-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

A counted ASCII string that contains a symbol name or an unsigned binary longword. The **key-string** argument is the address of a descriptor pointing to the key.

##### symbol-value

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Symbol value, the address of which LIB\$CRF\_INS\_KEY inserts in the cross-reference table. The **symbol-value** argument is the address of a signed longword integer containing this value. Both the key and value addresses must be permanent addresses in the user's symbol table.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$CRF\_INS\_KEY

#### flags

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Value used in selecting the contents of the KEY2 and VAL2 fields; **flags** is stored with the entry. The **flags** argument is the address of an unsigned longword containing the flags. When preparing the output line, LIB\$CRF\_OUTPUT uses **flags** and the 16-bit mask in the field descriptor table to extract the data. The high-order bit of the word is reserved for LIB\$CRF\_INS\_KEY.

## Description

LIB\$CRF\_INS\_KEY stores information to be printed in the KEY1, KEY2, VAL1, and VAL2 fields. When you call this routine, an entry for the key is made in the cross-reference table if the key is not present in the table. If the key is present, only the value address and value flag fields are updated.

Using LIB\$CRF\_INS\_KEY involves the following steps:

1. Define a table of control information using the \$CRFCTLTABLE macro.
2. Define each field of the output line using the \$CRFFIELD macro.
3. Using the \$CRFFIELDEND macro, specify the end of each set of macros that define a field in the output line.
4. Provide data by calling LIB\$CRF\_INS\_KEY to insert an entry for the specify key in the specified symbol table. This data is used to build tables in virtual memory.
5. Call LIB\$CRF\_OUTPUT, the cross-reference output routine, to summarize and format the data. Supply a routine that LIB\$CRF\_OUTPUT calls to print each line in the output file. Because you supply this routine, you can control the number of lines per page and the header lines.

## Condition Values Returned

None.

---

**LIB\$CRF\_INS\_REF****Insert Reference to a Key in the Cross-Reference Table**

The Insert Reference to a Key in the Cross-Reference Table routine inserts a reference to a key in a cross-reference symbol table.†

**Format**

LIB\$CRF\_INS\_REF control-table ,longword-integer-key ,reference-string ,longword-integer-reference  
,ref-definition-indicator

**Returns**

None.

**Arguments****control-table**

OpenVMS usage: vector\_longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference, array reference

Control table associated with this cross-reference. The **control-table** argument is the address of an array containing the control table.

**longword-integer-key**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Key referred to by LIB\$CRF\_INS\_REF. The **longword-integer-key** argument is the address of a signed longword integer containing the key. The key is a counted ASCII string that contains a symbol name or an unsigned binary longword. It must be a permanent address in the user's symbol table.

**reference-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Counted ASCII string with a maximum of 31 characters, not including the byte count. The **reference-string** argument is the address of a descriptor pointing to the counted ASCII string.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$CRF\_INS\_REF

#### longword-integer-reference

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

The 16-bit value used in selecting the contents of the REF1 field. The **longword-integer-reference** argument is the address of a signed longword integer containing this value. When preparing the output line, LIB\$CRF\_OUTPUT uses **longword-integer-reference** and the bit mask in the field descriptor table to extract the data. The high-order bit of the word is reserved for LIB\$CRF\_INS\_REF.

#### ref-definition-indicator

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Reference/definition indicator that LIB\$CRF\_INS\_REF uses to distinguish between a reference to a symbol and the definition of the symbol. The **ref-definition-indicator** argument is the address of a signed longword integer containing this indicator. The only difference between processing a symbol reference and a symbol definition is where LIB\$CRF\_INS\_REF stores the information.

The reference/definition indicator can have either of the following values:

| Symbolic Name | Description            |
|---------------|------------------------|
| CRF\$K_REF    | Reference to a symbol  |
| CRF\$K_DEF    | Definition of a symbol |

## Description

LIB\$CRF\_INS\_REF inserts a reference to a key in the cross-reference symbol table. If you attempt to insert reference information for a key that was not specified in a call to LIB\$CRF\_INS\_KEY, LIB\$CRF\_INS\_REF uses the address of the key to locate the symbol name and set the KEY1 field. Once set, either as a result of LIB\$CRF\_INS\_KEY or LIB\$CRF\_INS\_REF, the KEY1 field is never changed. A KEY1 field set by LIB\$CRF\_INS\_REF has a space-filled VAL1 field associated with it unless it is overridden by a subsequent call to LIB\$CRF\_INS\_KEY.

Using LIB\$CRF\_INS\_REF involves the following steps:

1. Define a table of control information using the \$CRFCTLTABLE macro.
2. Define each field of the output line using the \$CRFFIELD macro.
3. Using the \$CRFFIELDEND macro, specify the end of each set of macros that define a field in the output line.

## **LIB\$ Routines**

### **LIB\$CRF\_INS\_REF**

4. Provide data by calling LIB\$CRF\_INS\_REF to insert a reference to a key in the specified symbol table. This data is used to build tables in virtual memory.
5. Call LIB\$CRF\_OUTPUT, the cross-reference output routine, to summarize and format the data. Supply a routine that LIB\$CRF\_OUTPUT calls to print each line in the output file. Because you supply this routine, you can control the number of lines per page and the header lines.

#### **Condition Values Returned**

None.

---

## LIB\$CRF\_OUTPUT

### Output Cross-Reference Table Information

The Output Cross-Reference Table Information routine extracts the information from the cross-reference tables and formats the output pages.†

#### Format

LIB\$CRF\_OUTPUT control-table ,output-line-width ,page1 ,page2 ,mode-indicator ,delete-save-indicator

#### Returns

None.

#### Arguments

##### control-table

OpenVMS usage: vector\_longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference, array reference

Control table associated with the cross-reference. The **control-table** argument is the address of an array containing the control table. The table contains the address of the user-supplied routine that prints the lines formatted by LIB\$CRF\_OUTPUT.

##### output-line-width

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Width of the output line. The **output-line-width** argument is the address of a signed longword integer containing the width.

##### page1

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of lines on the first page of the output. The **page1** argument is the address of a signed longword integer containing this number. This allows the user to reserve space to print header information on the first page of the cross-reference.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

**page2**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Number of lines per page for the other pages. The **page2** argument is the address of a signed longword integer containing this number.

**mode-indicator**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Output mode indicator. The **mode-indicator** argument is the address of a signed longword integer containing the mode indicator.

This indicator allows the user to select which of three output modes is desired.

| Output Mode      | Description   |
|------------------|---|
| CRF\$K_VALUES    | Only the value and key fields are to be printed. LIB\$CRF_OUTPUT creates multiple columns across the page. Each column consists of the KEY1, KEY2, VAL1, and VAL2 fields. A minimum of one space between each column is guaranteed. |
| CRF\$K_VALS_REFS | Requests a cross-reference summary that has no column space saved for a defining reference. If the user inserted a reference with the CRF\$K_DEF indicator, the entry is ignored.   |
| CRF\$K_DEFS_REFS | Requests a cross-reference summary with the first REF1 and REF2 fields used only for definition references. If no definition reference is provided, the fields are filled with spaces.  |

**delete-save-indicator**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Delete/save indicator, which LIB\$CRF\_OUTPUT uses to determine whether the table's built-in accumulating symbol information is to be saved or deleted once the cross-reference is produced. The **delete-save-indicator** argument is the address of a signed longword integer containing the delete/save indicator.

The indicator can be either of the following:

- CRF\$K\_SAVE            To preserve the tables for subsequent processing
- CRF\$K\_DELETE        To delete the tables

# LIB\$ Routines

## LIB\$CRF\_OUTPUT

### Description

LIB\$CRF\_OUTPUT can format output lines for three types of cross-reference listings:

- A summary of symbol names and their values, as shown in Figure LIB-2.
- A summary of symbol names, their values, and the names of modules that refer to each symbol, as shown in Figure LIB-3.
- A summary of symbol names, their values, the names of the defining modules, and the names of those modules that refer to each symbol, as shown in Figure LIB-4.

**Figure LIB-2 Summary of Symbol Names and Values**

| Symbol         | Value       | Symbol           | Value       |
|----------------|-------------|------------------|-------------|
| BAS\$INSTR     | 000020B0-RU | BAS\$SCRATCH     | 00002308-RU |
| BAS\$IN_D_R    | 000021F0-RU | BAS\$STATUS      | 00002338-RU |
| BAS\$IN_F_R    | 000021E8-RU | BAS\$STR_D       | 000020C0-RU |
| BAS\$IN_L_R    | 000021E0-RU | BAS\$STR_F       | 000020B8-RU |
| BAS\$IN_T_DX   | 000021F8-RU | BAS\$STR_L       | 000020C8-RU |
| BAS\$IN_W_R    | 000021D8-RU | BAS\$UNLOCK      | 00002310-RU |
| BAS\$IO_END    | 000021D0-RU | BAS\$UPDATE      | 000022E8-RU |
| BAS\$LINKAGE   | 00001674-R  | BAS\$UPDATE_COUN | 000022F0-RU |
| BAS\$LINPUT    | 000021A8-RU | BAS\$VAL_D       | 00002110-RU |
| BAS\$MAT_INPUT | 00002268-RU | BAS\$VAL_F       | 00002108-RU |

ZK-1973-GE

**Figure LIB-3 Summary of Symbol Names, Values, and Names of Referring Modules**

| Symbol           | Value    | Referenced By ...  |
|------------------|----------|--|
| BAS\$K_DIVBY_ZER | 0000003D | ALLGBL<br>BAS\$POWDJ<br>BAS\$POWRJ<br>BAS\$ERROR<br>BAS\$POWII<br>BAS\$POWRR |
| BAS\$K_DUPKEYDET | 00000086 | ALLGBL<br>BAS\$SIGNAL_IO   |
| BAS\$K_ENDFILDEV | 0000000B | ALLGBL<br>BAS\$REC_PROC  |
| BAS\$K_ENDOF_STA | 0000006C | BAS\$UDF_RL<br>ALLGBL  |

ZK-1974-GE

**Figure LIB-4 Summary Indicating Defining Modules**

| Symbol           | Value      | Defined By     | Referenced By ...   |
|------------------|------------|----------------|---|
| LIB\$FREE_VM     | 0001E185-R | LIB\$VM        | ALLGBL<br>BAS\$MARGIN<br>BAS\$XLATE<br>FOR\$VM<br>STR\$APPEND<br>STR\$DUPL_CHAR<br>STR\$REPLACE |
| LIB\$GET_COMMAND | 0001E2B0-R | LIB\$GET_INPUT | ALLGBL  |
| LIB\$GET_COMMON  | 0001E4D6-R | LIB\$COMMON    | ALLGBL  |

ZK-1971-GE

Regardless of the format of the output, LIB\$CRF\_OUTPUT considers the output line as consisting of six different field types:

- KEY1** Is the first field in the line. It contains a symbol name.
- KEY2** Is the second field in the line. It contains a set of flags (for example, -R) that provide information about the symbol.
- VAL1** Is the third field in the line. It contains the value of the symbol.
- VAL2** Is the fourth field in the line. It contains a set of flags describing VAL1.
- REF1 and REF2 fields** Within each REF1 and REF2 pair, REF1 provides a set of flags, and REF2 provides the name of a module that references the symbol.

Any of these fields can be omitted from the output.

For example:

| Symbol     | Value       | Symbol       | Value       |
|------------|-------------|--------------|-------------|
| BAS\$INSTR | 000020B0-RU | BAS\$SCRATCH | 00002308-RU |
| KEY1       | VAL1 VAL2   | KEY1         | VAL1 VAL2   |

| Symbol       | Value      | Defined By           | Referenced By ...    |
|--------------|------------|----------------------|----------------------|
| LIB\$FREE_VM | 0001E185-R | LIB\$VM              | ALLGBL               |
| KEY1         | VAL1 VAL2  | REF2<br>(CRF\$K_DEF) | REF2<br>(CRF\$K_REF) |

### Condition Values Returned

None.

---

## LIB\$CURRENCY

### Get System Currency Symbol

The Get System Currency Symbol routine returns the system's currency symbol.

#### Format

LIB\$CURRENCY currency-string [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### currency-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Currency symbol. The **currency-string** argument is the address of a descriptor pointing to the currency symbol.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of characters that LIB\$CURRENCY has written into the **currency-string** argument, not counting padding in the case of a fixed-length string. The **resultant-length** argument is the address of an unsigned word containing the length of the currency symbol. If the input string is truncated to the size specified in the **currency-string** argument, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **currency-string**.

#### Description

LIB\$CURRENCY attempts to translate the logical name SYS\$CURRENCY as a process, group, or system logical name, in that order. If the translation fails, the routine returns the United States currency symbol (\$). If the translation succeeds, the text produced is returned. Thus, a system manager can define SYS\$CURRENCY as a systemwide logical name to provide a default for all users, and an individual user with a special need can define SYS\$CURRENCY as a process logical name to override the system default.

For example, if you want to use the British pound sign (£) as the currency symbol within your process but you want to leave the dollar sign as the system's default, define SYS\$CURRENCY to be the pound sign in your process logical name table. After this, any call to LIB\$CURRENCY within your process returns the pound sign (£), while any call outside your process returns the dollar sign (\$).

**Condition Values Returned**

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Successfully completed, but the currency string was truncated.   |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |

**Example**

```
10 !+
   ! This BASIC program uses LIB$CURRENCY to
   ! return the default system currency symbol.
   !-
   OUTLEN = 1
   CALL LIB$CURRENCY (CURR$, OUTLEN)
   PRINT CURR$
99 END
```

This BASIC program uses LIB\$CURRENCY to display the system currency symbol default. The output generated by the program is a dollar sign (\$).

---

## LIB\$CVTF\_FROM\_INTERNAL\_TIME

### Convert Internal Time to External Time (F-Floating-Point Value)

The Convert Internal Time to External Time (F-Floating-Point Value) routine converts a delta internal OpenVMS system time into an external F-floating time.

#### Format

LIB\$CVTF\_FROM\_INTERNAL\_TIME operation ,resultant-time ,input-time

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**operation**  
OpenVMS usage: function\_code  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

| Operation              | Interpretation     |
|------------------------|--------------------|
| LIB\$K_DELTA_WEEKS_F   | Fractional weeks   |
| LIB\$K_DELTA_DAYS_F    | Fractional days    |
| LIB\$K_DELTA_HOURS_F   | Fractional hours   |
| LIB\$K_DELTA_MINUTES_F | Fractional minutes |
| LIB\$K_DELTA_SECONDS_F | Fractional seconds |

**resultant-time**  
OpenVMS usage: floating\_point  
type: F\_floating  
access: write only  
mechanism: by reference

The external time that results from the conversion. The **resultant-time** argument is the address of an F-floating-point value containing the result.

## LIB\$ Routines LIB\$CVTF\_FROM\_INTERNAL\_TIME

### **input-time**

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Delta time to be converted. The **input-time** argument is the address of an unsigned quadword containing the time.

### **Description**

LIB\$CVTF\_FROM\_INTERNAL\_TIME converts a delta internal OpenVMS system time into an external F-floating-point time. The **operation** argument specifies the conversion. LIB\$\_CVTF\_FROM\_INTERNAL\_TIME converts the value of **input-time** into one of the external formats listed in the **operation** argument description. LIB\$\_CVTF\_FROM\_INTERNAL\_TIME then places the result into **resultant-time**.

### **Condition Values Returned**

|                 |   |
|-----------------|---|
| LIB\$_NORMAL    | Routine successfully completed.                 |
| LIB\$_DELTIMREQ | Delta time required but absolute time supplied. |
| LIB\$_IVTIME    | Invalid time.                                   |
| LIB\$_WRONUMARG | Incorrect number of arguments.                  |
| LIB\$_INVOPER   | Invalid operation.                              |

---

## LIB\$CVTF\_TO\_INTERNAL\_TIME

### Convert External Time to Internal Time (F-Floating-Point Value)

The Convert External Time to Internal Time (F-Floating-Point Value) routine converts an external time interval into an OpenVMS internal format F-floating delta time.

#### Format

LIB\$CVTF\_TO\_INTERNAL\_TIME operation ,input-time ,resultant-time

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**operation**  
OpenVMS usage: function\_code  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

| Operation              | Interpretation     |
|------------------------|--------------------|
| LIB\$K_DELTA_WEEKS_F   | Fractional weeks   |
| LIB\$K_DELTA_DAYS_F    | Fractional days    |
| LIB\$K_DELTA_HOURS_F   | Fractional hours   |
| LIB\$K_DELTA_MINUTES_F | Fractional minutes |
| LIB\$K_DELTA_SECONDS_F | Fractional seconds |

**input-time**  
OpenVMS usage: varying\_arg  
type: F\_floating  
access: read only  
mechanism: by reference

Delta time to be converted. The **input-time** argument is the address of this input time. The value you supply for **input-time** must not be negative, zero, or greater than 10,000 days.

**resultant-time**

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

The OpenVMS internal format delta time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

**Description**

LIB\$CVTF\_TO\_INTERNAL\_TIME converts an external time interval, such as 3.5 weeks, into an OpenVMS internal format F-floating delta time. The **operation** argument specifies the conversion. LIB\$\_CVTF\_TO\_INTERNAL\_TIME converts the value of **input-time** into one of the internal format delta times listed in the **operation** argument description. LIB\$\_CVTF\_TO\_INTERNAL\_TIME then places the result into **resultant-time**.

**Condition Values Returned**

|                 |                                 |
|-----------------|---------------------------------|
| LIB\$_NORMAL    | Routine successfully completed. |
| LIB\$_IVTIME    | Invalid time.                   |
| LIB\$_WRONUMARG | Incorrect number of arguments.  |
| LIB\$_INVOPER   | Invalid operation.              |

## LIB\$CVT\_DX\_DX General Data Type Conversion Routine

The General Data Type Conversion routine converts OpenVMS standard atomic or string data described by a source descriptor to OpenVMS standard atomic or string data described by a destination descriptor. This conversion is supported over a subset of the OpenVMS standard data types.

### Format

LIB\$CVT\_DX\_DX source-item ,destination-item [,word-integer-dest-length]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### source-item

OpenVMS usage: unspecified  
type: unspecified  
access: read only  
mechanism: by descriptor

Source item to be converted by LIB\$CVT\_DX\_DX. The **source-item** argument is the address of a descriptor pointing to the source item to be converted. The type of the item to be converted is contained in the descriptor.

The combination of source descriptor class and data type is restricted as described in Table LIB-1 and Table LIB-2.

#### destination-item

OpenVMS usage: unspecified  
type: unspecified  
access: write only  
mechanism: by descriptor

Destination of the conversion. The **destination-item** argument is the address of a descriptor pointing to the destination item. The destination descriptor specifies the data type to which the source item is converted.

The combination of destination descriptor class and data type is restricted as described in Table LIB-1 and Table LIB-2.

#### word-integer-dest-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length in bytes of the destination item (when that item is a string) that has been converted by LIB\$CVT\_DX\_DX, not including any space filling. The **word-integer-dest-length** argument contains the address of an unsigned word containing this length.

If the destination string is truncated, the returned length reflects the truncation. This word can be used by the calling program to determine if truncation has occurred or to extract the exact length of the string when the string contains space filling.

## Description

LIB\$CVT\_DX\_DX is a universal conversion utility routine. Table LIB-1 shows the complete matrix of data type and descriptor class combinations (as specified in the fields of the descriptor) supported by LIB\$CVT\_DX\_DX.

Conversion is defined over three sets of data types: atomic, string, and numeric byte data strings. Although some of the functions of this routine may be found in other Run-Time Library routines, LIB\$CVT\_DX\_DX packages the conversion functions with a general interface. Because of this general interface, the calling program does not have to specify what conversion should be done for which data type.

Refer to LIB\$CVT\_xTB if you want to convert the ASCII text string representation of a decimal, hexadecimal, or octal number into a binary representation.

The description of this routine has been divided into the following parts:

- Guidelines for Using LIB\$CVT\_DX\_DX
- Use of Numeric Byte Data Strings (NBDS)

For more information about numeric byte data strings, see the section called Use of Numeric Byte Data Strings (NBDS). Although the set of data types in NBDS is actually a subset of the atomic and string data types, the three sets are mutually exclusive in this routine. For more information on the OpenVMS atomic and string data types and the argument descriptor classes supported by this routine, see the *OpenVMS Calling Standard* manual.

**LIB\$ Routines**  
**LIB\$CVT\_DX\_DX**

**Table LIB-1 OpenVMS Descriptor Class and Data Type Combinations Accepted by LIB\$CVT\_DX\_DX**

| DSC\$K_<br>DTYPE_yyy | Descriptor Class |      |      |          |          |      |
|----------------------|------------------|------|------|----------|----------|------|
|                      | A                | D    | NCA  | S        | SD       | VS   |
| B                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| BU                   | NBDS             |      | NBDS | Non-NBDS |          |      |
| D                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| F                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| FS                   |                  |      |      | Non-NBDS | Non-NBDS |      |
| FT                   |                  |      |      | Non-NBDS | Non-NBDS |      |
| G                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| H                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| L                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| LU                   |                  |      |      | Non-NBDS |          |      |
| NL                   |                  |      |      | Non-NBDS | Non-NBDS |      |
| NLO                  |                  |      |      | Non-NBDS | Non-NBDS |      |
| NR                   |                  |      |      | Non-NBDS | Non-NBDS |      |
| NRO                  |                  |      |      | Non-NBDS | Non-NBDS |      |
| NU                   |                  |      |      | Non-NBDS | Non-NBDS |      |
| NZ                   |                  |      |      | Non-NBDS | Non-NBDS |      |
| P                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| Q                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| T                    | NBDS             | NBDS | NBDS | NBDS     | NBDS     |      |
| VT                   |                  |      |      |          |          | NBDS |
| W                    |                  |      |      | Non-NBDS | Non-NBDS |      |
| WU                   |                  |      |      | Non-NBDS |          |      |

Invalid combinations are blank. Any source data can be converted into any other destination data as long as they are both represented by one of the valid combinations.

**Note:** LIB\$CVT\_DX\_DX treats an array, described by a CLASS\_A or CLASS\_NCA descriptor, as a character string. NBDS must have the format defined in table Table LIB-2.

**Guidelines for Using LIB\$CVT\_DX\_DX**

The data type and descriptor class of the source and destination arguments determine how LIB\$CVT\_DX\_DX performs the conversion, according to the following rules:

- Scale is applied when indicated in the descriptor (descriptor CLASS\_SD only), and scaling is defined for the data type.
- No language-specific semantics are applied, such as BASIC scale for DSC\$K\_DTYPE\_D.
- Some conversions must use intermediate values to arrive at the destination requested. Although some loss of speed is inevitable, intermediate values will not cause a loss of precision.

- Results are always rounded instead of truncated, except for the case described below. Note that loss of precision or range may be inherent in the destination data type or in the NBDS destination size. No errors are reported if there is a loss of precision or range as a result of destination data type.
- When the destination is an NBDS and has fixed-string semantics, then if the source does not fill the destination, the destination is padded with blanks.
- When the source and destination are both NBDS and no scaling is requested, then a straight copy is done without translation or conversion, and truncation is possible. If scaling is requested, then a conversion takes place as defined in Table LIB-2.
- When the source is an NBDS and the destination is non-NBDS, if there is an invalid character in the source or the value is outside the range that can be represented by the destination, then LIB\$\_INVNBDS is returned.
- Attempts to convert a negative value to an unsigned data type cause the LIB\$\_INVCVT error to be returned.
- If the destination is an NBDS of descriptor CLASS\_D, then a new string of appropriate size is allocated for it, if necessary.
- Invalid conversions resulting in an error produce an unpredictable result.

#### **Use of Numeric Byte Data Strings (NBDS)**

For simplicity, and to define a generic numeric string that LIB\$CVT\_DX\_DX understands to be a numeric string, the set Numeric Byte Data String (NBDS) is defined to be the set of NBDS descriptors shown in Table LIB-1.

The combination of data type and descriptor class determines whether an argument is an NBDS. For example, LIB\$CVT\_DX\_DX treats the combination DSC\$K\_DTYPE\_B/DSC\$K\_CLASS\_S (unsigned byte scalar) as an atomic data type. However, the routine considers DSC\$K\_DTYPE\_BU/DSC\$K\_CLASS\_NCA (noncontiguous array of unsigned bytes) to be an NBDS.

A destination NBDS is always left-justified.

If a destination NBDS requires more than 50 digits for its format (including the sign, if any), then it is expressed in exponential format.

For a conversion of NBDS to NBDS, this format is used if scaling is requested. Otherwise, a straight copy is done. The format of a source NBDS is the same as the format defined for the input argument **inp** in OTS\$\_CVT\_T\_z, with bits 0, 2, and 4 set in the **flags** argument. That is, blanks are ignored, underflow causes an error, and tabs are ignored.

Table LIB-2 defines the format of a destination NBDS.

**LIB\$ Routines**  
**LIB\$CVT\_DX\_DX**

**Table LIB-2 LIB\$CVT\_DX\_DX Destination NBDS Formats**

| Source Data Type          | Destination NBDS Format                  |
|---------------------------|--|
| Byte integer (signed)     | sdigits                                  |
| Byte (unsigned)           | digits                                   |
| Word integer (signed)     | sdigits                                  |
| Word (unsigned)           | digits                                   |
| Longword integer (signed) | sdigits                                  |
| Longword (unsigned)       | digits                                   |
| Quadword integer (signed) | sdigits                                  |
| D_floating                | s0.min(16,w-7)E±nn                       |
| F_floating                | s0.min( 7,w-7)E±nn                       |
| G_floating                | s0.min(15,w-8)E±nnn                      |
| H_floating                | s0.min(33,w-9)E±nnnn                     |
| FS_floating (IEEE)        | s0.min(7,w-7)E±nn                        |
| FT_floating (IEEE)        | s0.min(15,w-8)E±nnn                      |
| NBDS                      | s0.min(33,w-9)E±nnnn                     |
| Decimal string            | sdigits (as defined by VAX architecture) |

**Key to Destination NBDS Formats**

- digits: Digits 0 through 9, and a decimal point only if source descriptor specifies the value of the SCALE field as less than 0.
- w: Width of destination in bytes.
- s: Sign. For positive numbers, the sign is implied.
- min: Minimum of two values.

The A and NCA array descriptor classes are supported with the following restrictions:

An array is written with the semantics of a fixed string.

- |                 |  |
|-----------------|--|
| DIMCT = 1       | Only one-dimensional arrays are recognized.  |
| LENGTH = 1      | The length of each array element must be a byte.   |
| ARSIZE ≤ 65,535 | The total size of the array must be less than 65,535 bytes. If ARSIZE = 0, the array has a length of zero.   |
| S1 = 1          | The stride of an array passed by a noncontiguous array descriptor must be 1. That is, even if the class of the array's descriptor is noncontiguous array (NCA), the array itself must be contiguous. |

For more information about the semantics of writing output strings, see the *OpenVMS RTL String Manipulation (STR\$) Manual*.

If the calling program passes a descriptor to LIB\$CVT\_DX\_DX that does not comply with Table LIB-1, one of the following error messages is returned:

```
LIB$_INVDTYDSC
LIB$_INVCLADSC
LIB$_INVCLADTY
LIB$_INVNBDS
```

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_DECOVF    | Packed decimal overflow error. Severe error.  |
| LIB\$_FLTQVF    | Floating overflow error. Severe error.  |
| LIB\$_FLTQND    | Floating underflow error. Severe error.   |
| LIB\$_INVCLADSC | Invalid class in descriptor. This class of descriptor is not supported. Severe error.   |
| LIB\$_INVCLADTY | Invalid class and data type in descriptor. This class and data type combination is not supported. Severe error.   |
| LIB\$_INVCVT    | If the source value is negative and the destination data type is unsigned, this error is returned.  |
| LIB\$_INVDTYDSC | Invalid data type in descriptor. This data type is not supported. Severe error.   |
| LIB\$_INTQVF    | Integer overflow error. Severe error.   |
| LIB\$_INVNBD    | Invalid NBD. There is an invalid character in the input, or the value is outside the range that can be represented by the destination, or the NBD descriptor is invalid. This error is also signaled when the array size of an NBD is larger than 65,535 bytes or the array is multi-dimensional. |
| LIB\$_OUTSTRTRU | Output string truncated. This is returned only when NBD is both source and destination and no scaling is requested. The result is truncated.  |
| LIB\$_ROPRAND   | Reserved operand error. Severe error.   |

# LIB\$ Routines

## LIB\$CVT\_FROM\_INTERNAL\_TIME

---

### LIB\$CVT\_FROM\_INTERNAL\_TIME

#### Convert Internal Time to External Time

The Convert Internal Time to External Time routine converts an internal OpenVMS system time (either absolute or delta) into an external time.

#### Format

LIB\$CVT\_FROM\_INTERNAL\_TIME operation ,resultant-time [,input-time]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**operation**  
OpenVMS usage: function\_code  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword containing the operation. The following table shows valid values for **operation**:

| Operation              | Return Range    | Type                  |
|------------------------|-----------------|-----------------------|
| LIB\$K_MONTH_OF_YEAR   | 1 to 12         | Absolute              |
| LIB\$K_DAY_OF_YEAR     | 1 to 366        | Absolute              |
| LIB\$K_HOUR_OF_YEAR    | 1 to 8784       | Absolute              |
| LIB\$K_MINUTE_OF_YEAR  | 1 to 527,040    | Absolute              |
| LIB\$K_SECOND_OF_YEAR  | 1 to 31,622,400 | Absolute              |
| LIB\$K_DAY_OF_MONTH    | 1 to 31         | Absolute              |
| LIB\$K_HOUR_OF_MONTH   | 1 to 744        | Absolute              |
| LIB\$K_MINUTE_OF_MONTH | 1 to 44,640     | Absolute              |
| LIB\$K_SECOND_OF_MONTH | 1 to 2,678,400  | Absolute              |
| LIB\$K_DAY_OF_WEEK     | 1 to 7          | Absolute <sup>1</sup> |
| LIB\$K_HOUR_OF_WEEK    | 1 to 168        | Absolute <sup>2</sup> |
| LIB\$K_MINUTE_OF_WEEK  | 1 to 10,080     | Absolute <sup>3</sup> |
| LIB\$K_SECOND_OF_WEEK  | 1 to 604,800    | Absolute <sup>4</sup> |
| LIB\$K_HOUR_OF_DAY     | 0 to 23         | Absolute              |
| LIB\$K_MINUTE_OF_DAY   | 0 to 1439       | Absolute              |

<sup>1</sup>Day 1 is Monday.

<sup>2</sup>Hours since midnight on previous Monday.

<sup>3</sup>Minutes since midnight on previous Monday.

<sup>4</sup>Seconds since midnight on previous Monday.

## LIB\$ Routines

### LIB\$CVT\_FROM\_INTERNAL\_TIME

| Operation               | Return Range | Type                  |
|-------------------------|--------------|-----------------------|
| LIB\$K_SECOND_OF_DAY    | 0 to 86,399  | Absolute              |
| LIB\$K_MINUTE_OF_HOUR   | 0 to 59      | Absolute              |
| LIB\$K_SECOND_OF_HOUR   | 0 to 3599    | Absolute              |
| LIB\$K_SECOND_OF_MINUTE | 0 to 59      | Absolute              |
| LIB\$K_JULIAN_DATE      | Julian date  | Absolute <sup>5</sup> |
| LIB\$K_DELTA_WEEKS      |              | Delta <sup>6</sup>    |
| LIB\$K_DELTA_DAYS       |              | Delta <sup>7</sup>    |
| LIB\$K_DELTA_HOURS      |              | Delta <sup>8</sup>    |
| LIB\$K_DELTA_MINUTES    |              | Delta <sup>9</sup>    |
| LIB\$K_DELTA_SECONDS    |              | Delta <sup>10</sup>   |

<sup>5</sup>Number of days since system zero time (17–Nov–1858).

<sup>6</sup>Whole weeks.

<sup>7</sup>Whole days.

<sup>8</sup>Whole hours.

<sup>9</sup>Whole minutes.

<sup>10</sup>Whole seconds.

#### resultant-time

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: write only  
 mechanism: by reference

The external time that results from the conversion. The **resultant-time** argument is the address of an unsigned longword containing the result.

#### input-time

OpenVMS usage: date\_time  
 type: quadword (unsigned)  
 access: read only  
 mechanism: by reference

Optional absolute or delta time to be converted. The **input-time** argument is the address of an unsigned quadword containing the time. If you do not supply a value for **input-time**, the current system time is used.

## Description

LIB\$CVT\_FROM\_INTERNAL\_TIME converts an internal OpenVMS system time (either absolute or delta) into an external time. The **operation** argument specifies the conversion. LIB\$CVT\_FROM\_INTERNAL\_TIME converts the value of **input-time** (or the current system time if **input-time** is not supplied) into one of the external formats listed in the **operation** argument description. LIB\$CVT\_FROM\_INTERNAL\_TIME then places the result into **resultant-time**.

See the *OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

**LIB\$ Routines**  
**LIB\$CVT\_FROM\_INTERNAL\_TIME**

**Condition Values Returned**

|                 |   |
|-----------------|---|
| LIB\$_NORMAL    | Routine successfully completed.                 |
| LIB\$_IVTIME    | Invalid time.                                   |
| LIB\$_WRONUMARG | Incorrect number of arguments.                  |
| LIB\$_INVOPER   | Invalid operation.                              |
| LIB\$_ABSTIMREQ | Absolute time required but delta time supplied. |
| LIB\$_DELTIMREQ | Delta time required but absolute time supplied. |

## LIB\$CVT\_TO\_INTERNAL\_TIME

### Convert External Time to Internal Time

The Convert External Time to Internal Time routine converts an external time interval into an OpenVMS internal format delta time.

#### Format

LIB\$CVT\_TO\_INTERNAL\_TIME operation ,input-time ,resultant-time

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

**operation**  
 OpenVMS usage: function\_code  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

The conversion to be performed. The **operation** argument is the address of an unsigned longword specifying the operation. Valid values for **operation** are the following:

| Operation            | Interpretation              |
|----------------------|-----------------------------|
| LIB\$K_DELTA_WEEKS   | Whole weeks in delta time   |
| LIB\$K_DELTA_DAYS    | Whole days in delta time    |
| LIB\$K_DELTA_HOURS   | Whole hours in delta time   |
| LIB\$K_DELTA_MINUTES | Whole minutes in delta time |
| LIB\$K_DELTA_SECONDS | Whole seconds in delta time |

**input-time**  
 OpenVMS usage: varying\_arg  
 type: longword (signed)  
 access: read only  
 mechanism: by reference

Delta time to be converted. The **input-time** argument is the address of this input time. The value you supply for **input-time** must not be negative, zero, or greater than 10,000 days.

## LIB\$ Routines

### LIB\$CVT\_TO\_INTERNAL\_TIME

#### resultant-time

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

The OpenVMS internal format delta time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

## Description

LIB\$CVT\_TO\_INTERNAL\_TIME converts an external time interval, such as three weeks, into an OpenVMS internal format delta time. The **operation** argument specifies the conversion. LIB\$\_CVT\_TO\_INTERNAL\_TIME converts the value of **input-time** into one of the internal format delta times listed in the **operation** argument description. LIB\$\_CVT\_TO\_INTERNAL\_TIME then places the result into **resultant-time**.

See the *OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

## Condition Values Returned

|                 |                                 |
|-----------------|---------------------------------|
| LIB\$_NORMAL    | Routine successfully completed. |
| LIB\$_IVTIME    | Invalid time.                   |
| LIB\$_WRONUMARG | Incorrect number of arguments.  |
| LIB\$_INVOPER   | Invalid operation.              |

## LIB\$CVT\_VECTIM

### Convert 7-Word Vector to Internal Time

The Convert 7-Word Vector to Internal Time routine converts a 7-word vector into an OpenVMS internal format delta or absolute time.

#### Format

LIB\$CVT\_VECTIM input-time ,resultant-time

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

##### input-time

OpenVMS usage: vector\_word\_unsigned  
 type: word (unsigned)  
 access: read only  
 mechanism: by reference, array reference

Time to be converted. The **input-time** argument is the address of a 7-word structure containing this time. This vector directly corresponds to a \$NUMTIM *timbuf* structure. The following diagram depicts the fields in this structure:



ZK-7968-GE

The **input-time** argument can represent an absolute or a delta time. In order for **input-time** to represent a delta time, the **year since 0** and **month of year** fields must equal zero. If those fields do not equal zero, an absolute time is returned.

##### resultant-time

OpenVMS usage: date\_time  
 type: quadword (unsigned)  
 access: write only  
 mechanism: by reference

The OpenVMS internal format delta or absolute time that results from the conversion. The **resultant-time** argument is the address of an unsigned quadword containing the result.

## LIB\$ Routines

### LIB\$CVT\_VECTIM

#### Description

LIB\$CVT\_VECTIM converts a 7-word vector (in the format output by the system service SYS\$NUMTIM) into an OpenVMS internal format delta or absolute time. LIB\$CVT\_VECTIM then places the result into **resultant-time**.

See the *OpenVMS System Services Reference Manual* for more information about SYS\$NUMTIM.

#### Condition Values Returned

|                 |                                 |
|-----------------|---------------------------------|
| LIB\$_NORMAL    | Routine successfully completed. |
| LIB\$_IVTIME    | Invalid time.                   |
| LIB\$_WRONUMARG | Incorrect number of arguments.  |

---

## LIB\$CVT\_xTB

### Convert Numeric Text to Binary

The Convert Numeric Text to Binary routines return a binary representation of the ASCII text string representation of a decimal, hexadecimal, or octal number.

#### Format

LIB\$CVT\_DTB byte-count ,numeric-string ,result

LIB\$CVT\_HTB byte-count ,numeric-string ,result

LIB\$CVT\_OTB byte-count ,numeric-string ,result

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### byte-count

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by value

Byte count of the input ASCII text string. The **byte-count** argument is a signed longword integer containing the byte count of the input string.

##### numeric-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by reference

ASCII text string representation of a decimal, hexadecimal, or octal number that LIB\$CVT\_xTB converts to binary representation. The **numeric-string** argument is the address of a character string containing this input string to be converted.

The syntax of a valid ASCII text input string is as follows:

[ + ] <radix-characters>  
[ - ]

LIB\$CVT\_xTB allows only an optional plus (+) or minus (-) sign followed by a string of decimal, hexadecimal, or octal characters appropriate to the routine being called.

##### result

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

## LIB\$ Routines

### LIB\$CVT\_xTB

Binary representation of the input string. The **result** argument is the address of a signed longword integer containing the converted string.

### Description

LIB\$CVT\_DTB converts the ASCII text string representation of a decimal number into binary representation. LIB\$CVT\_HTB converts the ASCII text string representation of a hexadecimal number into binary representation. LIB\$CVT\_OTB converts the ASCII text string representation of an octal number into binary representation.

---

#### Note

---

LIB\$CVT\_DTB, LIB\$CVT\_HTB, and LIB\$CVT\_OTB are intended to be called primarily from BLISS and MACRO programs. Therefore, the routines expect input scalar arguments to be passed by value and strings by reference.

---

### Condition Values Returned

|   |   |
|---|---|
| 1 | Routine successfully completed.   |
| 0 | Nonradix character in the input string or a sign in any position other than the first character. An overflow from 32 bits (unsigned) causes an error. |

## LIB\$CVT\_xTB\_64 (Alpha Only) Convert Numeric Text to Binary

The Convert Numeric Text to Binary routines return a binary representation of the ASCII text string representation of a decimal, hexadecimal, or octal number.

### Format

LIB\$CVT\_DTB\_64 byte-count ,numeric-string ,result

LIB\$CVT\_HTB\_64 byte-count ,numeric-string ,result

LIB\$CVT\_OTB\_64 byte-count ,numeric-string ,result

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### byte-count

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by value

Byte count of the input ASCII text string. The **byte-count** argument is a signed longword integer containing the byte count of the input string.

#### numeric-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by reference

ASCII text string representation of a decimal, hexadecimal, or octal number that LIB\$CVT\_xTB\_64 converts to binary representation. The **numeric-string** argument is the address of a character string containing this input string to be converted.

The syntax of a valid ASCII text input string is as follows:

[ + ] <radix-characters>  
[ - ]

LIB\$CVT\_xTB\_64 allows only an optional plus (+) or minus (-) sign followed by a string of decimal, hexadecimal, or octal characters appropriate to the routine being called.

## LIB\$ Routines

### LIB\$CVT\_xTB\_64 (Alpha Only)

#### result

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: write only  
mechanism: by reference

Binary representation of the input string. The **result** argument is the address of a signed quadword integer containing the converted string.

## Description

LIB\$CVT\_DTB\_64 converts the ASCII text string representation of a decimal number into binary representation. LIB\$CVT\_HTB\_64 converts the ASCII text string representation of a hexadecimal number into binary representation. LIB\$CVT\_OTB\_64 converts the ASCII text string representation of an octal number into binary representation.

---

#### Note

---

LIB\$CVT\_DTB\_64, LIB\$CVT\_HTB\_64, and LIB\$CVT\_OTB\_64 are intended to be called primarily from BLISS and MACRO programs. Therefore, the routines expect input scalar arguments to be passed by value and strings by reference.

---

## Condition Values Returned

|   |   |
|---|---|
| 1 | Routine successfully completed.   |
| 0 | Nonradix character in the input string or a sign in any position other than the first character. An overflow from 64 bits (unsigned) causes an error. |

---

## LIB\$DATE\_TIME

### Date and Time Returned as a String

The Date and Time Returned as a String routine returns the OpenVMS system date and time in the semantics of a user-provided string.

#### Format

LIB\$DATE\_TIME date-time-string

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Argument

**date-time-string**  
 OpenVMS usage: time\_name  
 type: character string  
 access: write only  
 mechanism: by descriptor

Destination string into which LIB\$DATE\_TIME writes the system date and time. The **date-time-string** argument is the address of a descriptor pointing to the destination string. This string is 23 characters long; its format is as follows:

dd-mmm-yyyy hh:mm:ss.hh

#### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Success, but destination string was truncated.   |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory. |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.    |

## LIB\$ Routines

### LIB\$DATE\_TIME

#### Example

```
10 !+
   ! This BASIC program demonstrates the
   ! use of LIB$DATE_TIME.
   !-
   CALL LIB$DATE_TIME(DSTSTR$)
   PRINT DSTSTR$
99 END
```

This BASIC program uses LIB\$DATE\_TIME to display the current system date and time. The output generated by one run of this program follows:

```
26-JUL-1995 13:41:22.67
```

---

**LIB\$DAY****Day Number Returned as a Longword Integer**

The Day Number Returned as a Longword Integer routine returns the number of days since the system zero date of November 17, 1858, or the number of days from November 17, 1858, to a user-supplied date.

**Format**

LIB\$DAY number-of-days [,user-time] [,day-time]

**Returns**

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

**Arguments****number-of-days**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Number of days since the system zero date. The **number-of-days** argument is the address of a signed longword integer containing the day number.

**user-time**

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

User-supplied time, in 100-nanosecond units. The **user-time** argument is the address of a signed quadword integer containing the user time. A positive value indicates an absolute time, while a negative value indicates a delta time. This is an optional argument. If **user-time** is omitted, the default is the current system time. This quadword time value is obtained by calling the system service SYS\$BINTIM.

If time is passed as zero by value, the numeric value for the current day is returned. If time is passed as a zero by reference, the number returned represents the day of November 17, 1858, rather than the current day.

**day-time**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Number of 10-millisecond units since midnight of the **user-time** argument. The **day-time** argument is the address of a signed longword integer into which LIB\$DAY writes this number of units.

## LIB\$ Routines

### LIB\$DAY

#### Description

LIB\$DAY returns the number of days since the system zero date of November 17, 1858. Optionally, the caller can supply a time in system time format to be used instead of the current system time. In this case, LIB\$DAY returns the number of days from November 17, 1858, to the user-supplied date.

The number of 10-millisecond units since midnight is an optional return argument.

---

#### Note

---

If the caller supplies a quadword time, it is not verified. If it is negative (bit 63 on), the **number-of-days** value returned is negative.

---

The Run-Time Library provides the date/time utility routines for languages that do not have built-in time and date functions and for particular applications that require the time or date in a different format from the one that the language supplies. In general, it is simpler to call the Run-Time Library routines for the system date and time than to call a system service.

#### Condition Values Returned

SS\$\_NORMAL                      Routine successfully completed.

#### Example

```
PROGRAM DAY(INPUT, OUTPUT);
{+}
{ This is a VAX Pascal example program showing
{ the use of LIB$DAY.
{-}
VAR
  DAYNUMBER : INTEGER;
routine LIB$DAY(VAR DAYNUM : INTEGER);
  EXTERN;
BEGIN
  LIB$DAY(DAYNUMBER);
  WRITELN('The day number is ', DAYNUMBER);
END.
```

This Pascal program retrieves and prints the day number. A sample of the output generated by this program is as follows.

```
The day number is 46738
```

---

## LIB\$DAY\_OF\_WEEK

### Show Numeric Day of Week

The Show Numeric Day of Week routine returns the numeric day of the week for an input time value. If 0 is the input time value, the current day of the week is returned. The days are numbered 1 through 7, with Monday as day 1 and Sunday as day 7.

#### Format

LIB\$DAY\_OF\_WEEK [user-time,] day-number

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

##### user-time

OpenVMS usage: date\_time  
 type: quadword (unsigned)  
 access: read only  
 mechanism: by reference

Time to be translated to a day of the week, or zero. The optional **user-time** argument is the address of an unsigned quadword containing the value of time. Time must be supplied as an absolute system time. To obtain this time value in proper quadword format, call the system service SYS\$BINTIM.

If time is passed as zero by value, the numeric value for the current day is returned. If time is passed as a zero by reference, the number returned represents the day of November 17, 1858, rather than the current day. If the **user-time** argument is omitted, it is equivalent to passing a zero by value.

##### day-number

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: write only  
 mechanism: by reference

Numeric day of week. The **day-number** argument is the address of a longword into which LIB\$DAY\_OF\_WEEK writes the integer value representing the day of the week.

#### Condition Values Returned

SS\$\_NORMAL                      Routine successfully completed.

## LIB\$ Routines

### LIB\$DAY\_OF\_WEEK

#### Example

```
PROGRAM DAYOFWEEK(INPUT, OUTPUT);
{+}
{ This is an example showing
{ the use of LIB$DAY_OF_WEEK.
{-}
VAR
  OUTDAT : INTEGER;
routine LIB$DAY_OF_WEEK(TIM : INTEGER; %REF OUTDA : INTEGER); EXTERN;
BEGIN
  LIB$DAY_OF_WEEK(%IMMED 0, OUTDAT);
  WRITELN(OUTDAT);
END.
```

This Pascal program shows the use of LIB\$DAY\_OF\_WEEK. This example was tested on a Monday, and the output generated was 1.

## LIB\$DECODE\_FAULT

### Decode Instruction Stream During Fault

The Decode Instruction Stream During Fault routine is a tool for building condition handlers that process instruction fault exceptions. It is called from a condition handler.†

**Alpha**

This routine is not available to native OpenVMS Alpha programs but is available to translated VAX images. ♦

#### Format

```
LIB$DECODE_FAULT signal-arguments ,mechanism-arguments ,user-procedure
                  [,unspecified-user-argument] [,instruction-definitions]
```

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

##### signal-arguments

OpenVMS usage: vector\_longword\_unsigned  
 type: unspecified  
 access: read only  
 mechanism: by reference, array reference

Signal arguments array that was passed from the OpenVMS operating system to your condition handler. The **signal-arguments** argument is the address of the signal arguments array.

##### mechanism-arguments

OpenVMS usage: vector\_longword\_unsigned  
 type: unspecified  
 access: read only  
 mechanism: by reference, array reference

Mechanism arguments array that was passed from OpenVMS to your condition handler. The **mechanism-arguments** argument is the address of the mechanism arguments array.

##### user-procedure

OpenVMS usage: procedure  
 type: procedure value  
 access: call after stack unwind  
 mechanism: by descriptor, procedure descriptor

User-supplied action routine that LIB\$DECODE\_FAULT calls to handle the exception. The **user-procedure** argument is the address of a descriptor pointing to your user action routine. The **user-procedure** argument may be of type

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$DECODE\_FAULT

“procedure value” when called by languages with up-level addressing. If **user-procedure** is not of type “bound routine value,” it is assumed to be the address of an entry mask.

For further information on the user action routine, see Call Format for a User Action Routine in the Description section.

#### unspecified-user-argument

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

Additional information passed from your handler without interpretation to your user action routine. The **unspecified-user-argument** argument contains the value of this additional information. The **unspecified-user-argument** argument is optional; if it is omitted, zero is used as the default.

#### instruction-definitions

OpenVMS usage: vector\_byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference, array reference

Array of bytes specifying instruction opcodes and operand definitions that are to replace or supplement the standard instruction definitions. The **instruction-definitions** argument is the address of this array.

If **instruction-definitions** is omitted, only the standard instruction definitions are used. If supplied, **instruction-definitions** is searched first, followed by the standard definitions.

Each instruction definition consists of a series of bytes, the first one or two of which is the instruction opcode. If the instruction is a 2-byte opcode, the escape byte, which must be hex FD, FE, or FF, is placed in the first of the two bytes. Following the opcode may be from 0 to 16 operand definition bytes. These bytes indicate the operand’s access type and data type.

The end of each instruction definition is denoted by a byte containing the value LIB\$K\_DCFOPR\_END (zero). The list of instruction definitions is terminated by two bytes, each of which contains the value -1 (hexadecimal FF). For further information, see Instruction Operand Definition Codes in the Description section.

## Description

The Description section of the LIB\$DECODE\_FAULT routine is divided into five parts:

- Guidelines for Using LIB\$DECODE\_FAULT
- Exceptions Recognized by LIB\$DECODE\_FAULT
- Instruction Operand Definition Codes
- Call Format for a User Action Routine
- Call Format for a Signal Routine

### Guidelines for Using LIB\$DECODE\_FAULT

LIB\$DECODE\_FAULT is a tool for building condition handlers that process instruction fault exceptions. Called from a condition handler, LIB\$DECODE\_FAULT performs the following actions:

1. Unwinds intermediate stack frames back to that of the exception
2. Decodes the instruction stream to determine the operation and its operands
3. Calls a user-supplied action routine and passes it a consistent and easy-to-access description of the instruction's context

Your user action routine performs whatever tasks are necessary to handle the fault and returns to LIB\$DECODE\_FAULT. LIB\$DECODE\_FAULT then restores the context as modified by your user action routine and continues execution.

Your condition handler must first decide whether or not it wants to handle the exception. The signal arguments list contains the exception code and the address of the program context (PC) that is usually sufficient for this determination. Once LIB\$DECODE\_FAULT is called, if the exception is a fault LIB\$DECODE\_FAULT can analyze, control does not return to the condition handler. Therefore, your handler must not depend on regaining control by a routine return once it has called LIB\$DECODE\_FAULT. With your user action routine, LIB\$DECODE\_FAULT makes the original fault disappear.

---

#### Note

---

Your user action routine is capable of generating a new exception, including one that looks identical to the original exception. Your user action routine may also resignal, but if the decision to resignal is made inside the user action routine, all post-signal stack frames are lost.

---

Once your condition handler has decided that it wants to handle the exception, it calls LIB\$DECODE\_FAULT, passing as arguments the addresses of the signal and mechanism argument lists and a descriptor for your user action routine entry point. LIB\$DECODE\_FAULT then performs the following actions:

1. Determines if the exception is a fault it understands. If not, it returns SS\$\_RESIGNAL.
2. Determines the context in which the exception occurred, including register and processor status longword (PSL) contents, and saves it.
3. Unwinds all stack frames back to that frame in which the exception occurred.
4. Evaluates each operand's addressing mode, computing the resulting location for the operand. Immediate mode operands are expanded into their full form. If an invalid addressing mode is found, an SS\$\_RADDRMOD exception is generated.
5. Unless the original exception was SS\$\_ACCVIO, tests each operand for accessibility. If necessary, an access violation is signaled as if the instruction had tried to execute normally. See the paragraph following this list for more information.
6. Unless the original exception was SS\$\_ROPRAND, tests each floating-point operand that is to be read for a reserved floating operand. If necessary, a reserved operand fault is signaled. See the paragraph following this list for more information.

## LIB\$ Routines

### LIB\$DECODE\_FAULT

7. Determines the address of the next sequential instruction.
8. Calls your user action routine with arguments as described below.
9. Upon return from your user action routine, reflects changes to the registers and PSL and continues execution at the instruction address specified by your user action routine. Optionally, your user action routine may resignal the original exception.

Some instructions can generate more than one fault if evaluation of one operand causes a fault that occurs before a later operand (which would also cause a fault). An example of this is the possibility that a floating-point divide instruction might report a divide-by-zero fault upon seeing a zero divisor before noticing that the dividend was a reserved operand or was inaccessible.

In these cases, operand-specific faults are signaled immediately by LIB\$DECODE\_FAULT in the expectation that another condition handler (or the same one) can repair the situation. This may reorder the sequence of exceptions as seen by a program. If the operand exception is corrected, the original exception reoccurs, and the proper action is taken.

If at all possible, try to determine if a resignal is necessary inside the condition handler that calls LIB\$DECODE\_FAULT, rather than inside your user action routine. The reason for this is that LIB\$DECODE\_FAULT removes all post-signal stack frames before calling your user action routine.

Your user action routine may fetch and store the operands, **registers**, and **PSL** as necessary for handling the exception. You should follow the VAX architecture rule of reading all input operands in left-to-right order, then writing all output operands in left-to-right order, to avoid inconsistent results with overlapping operands. This is especially necessary with register operands.

**PSL** may be modified in a manner consistent with the VAX architecture. If the T-bit in the PSL was set at the beginning of the instruction, LIB\$DECODE\_FAULT sets the TP bit. To initiate tracing, you must set only the T bit. To disable tracing, you must clear both the T and TP bits. See the *VAX Architecture Reference Manual* for more information.

If the first-part-done (FPD) bit in the PSL was set when the instruction faulted, LIB\$DECODE\_FAULT only advances the PC over the instruction; it does not reevaluate the operands, and it sets **operand-count** to zero. It is assumed that if FPD is set, the operands are in known locations (typically the registers).

For the CASEB, CASEW, and CASEL instructions, only the **selector**, **base**, and **limit** operands are represented in **operand-count** and **read-operand-locations**. The element of registers that corresponds to the PC, described in the following text as R15, points to the first of the word-length displacements. Your user action routine must modify R15 to reflect the location of the next instruction to execute.

The standard instruction definitions used by LIB\$DECODE\_FAULT specify the XFC instruction (which causes an SS\$\_OPCCUS fault) as having zero operands. You may redefine XFC if needed using the **instruction-definitions** argument to LIB\$DECODE\_FAULT.

If you do not want instruction execution to resume with the next sequential instruction, you must modify R15 appropriately. Your user action routine then returns to LIB\$DECODE\_FAULT, which restores the registers and PSL, and resumes instruction execution. See also the LIB\$\_RESTART condition value in the section called Condition Values Returned from the User Action Routine.

---

**Note**

---

Vector context is not saved or restored.

---

**Exceptions Recognized by LIB\$DECODE\_FAULT**

LIB\$DECODE\_FAULT recognizes the following VAX faults:

- SS\$\_ACCVIO, access violation.
- SS\$\_BREAK, breakpoint fault.
- SS\$\_FLTDIV\_F, floating divide by zero.
- SS\$\_FLTOVF\_F, floating overflow.
- SS\$\_FLTUND\_F, floating underflow.
- SS\$\_OPCCUS, opcode reserved to customers.
- SS\$\_OPCDEC, opcode reserved to Digital.
- SS\$\_ROPRAND, reserved operand.
- SS\$\_TBIT, T-bit pending trap. This is actually a fault caused by the TP bit being set at the beginning of instruction execution. It allows you to interpret all instructions by setting the PSL T-bit and allowing each instruction to trace-fault.

All other exceptions, including SS\$\_COMPAT and SS\$\_RADDRMOD, cause LIB\$DECODE\_FAULT to return immediately with the return status SS\$\_RESIGNAL.

SS\$\_COMPAT is generated by compatibility-mode instructions. LIB\$DECODE\_FAULT does not handle compatibility-mode instructions.

SS\$\_RADDRMOD is generated by a reserved addressing-mode fault. LIB\$DECODE\_FAULT assumes that all instructions follow VAX addressing-mode specifications.

**Instruction Operand Definition Codes**

Each instruction operand has an access type (read, write, . . . ) and a data type (byte, word, . . . ) associated with it. The operand definition codes used in both the **instruction-definitions** argument passed to LIB\$DECODE\_FAULT and in the **operand-types** argument passed to the user action routine encode the access and data types in a byte. The fields and values for operand access and data types are described using the symbols in Table LIB-3. These symbols are defined in Digital-supplied symbol definition libraries as macro or module name \$LIBDCFDEF.

**LIB\$ Routines**  
**LIB\$DECODE\_FAULT**

**Table LIB-3 Symbols for Fields and Values for Operand Access and Data Types Using LIB\$DECODE\_FAULT**

| Symbol        | Description   |
|---------------|---|
| LIB\$V_DCFACC | The field of the operand description code that describes the operand access type (bits 0-2).  |
| LIB\$\$DCFACC | The size of the access type field (3 bits).   |
| LIB\$M_DCFACC | The mask for the access type field. This is a 3-bit field that can contain any binary value from 000 through 111. The integer value of these bit settings defines the operand access type code for the LIB\$M_DCFACC field. Currently, six codes are defined. These codes have symbolic names and are explained below. It is important to remember that LIB\$M_DCFACC is not a bit mask. The values 0 through 6 do not refer to bits 0 through 6. They represent the binary values 001 through 110 as contained in the 3-bit field.<br>The operand access type codes defined for the LIB\$M_DCFACC field are:<br>LIB\$K_DCFACC_R = 1      Operand is read-only.<br>LIB\$K_DCFACC_M = 2      Operand is to be modified.<br>LIB\$K_DCFACC_W = 3      Operand is write-only.<br>LIB\$K_DCFACC_A = 4      Operand is an address (must not be a register).<br>LIB\$K_DCFACC_V = 5      Operand is the base of a bit field (same as address except that it may be a register).<br>LIB\$K_DCFACC_B = 6      Operand is a branch address. |
| LIB\$V_DCFTYP | The field of the operand descriptor code that describes the operand data type (bits 3-7).   |
| LIB\$\$DCFTYP | The size of the operand data type field (5 bits).   |

(continued on next page)

**Table LIB-3 (Cont.) Symbols for Fields and Values for Operand Access and Data Types Using LIB\$DECODE\_FAULT**

| Symbol              | Description  |
|---------------------|--|
| LIB\$M_DCFDYP       | The mask for the operand data type field. This is a 5-bit field (bits 3-7) that can contain any binary value from 00000 through 11111. The integer value of these bit settings defines the operand access type code for the LIB\$M_DCFACC field. Currently, nine codes are defined. These codes have symbolic names and are explained below. It is important to remember that LIB\$M_DCFDYP is not a bit mask. The values 0 through 9 do not refer to bits 0 through 9. They represent the binary values 00001 through 01001 as contained in the 5-bit field. The operand access type codes defined for the LIB\$V_DCFDYP field are: |
| LIB\$K_DCFDYP_B = 1 | Operand is a byte.   |
| LIB\$K_DCFDYP_W = 2 | Operand is a word.   |
| LIB\$K_DCFDYP_L = 3 | Operand is a longword.   |
| LIB\$K_DCFDYP_Q = 4 | Operand is a quadword.   |
| LIB\$K_DCFDYP_O = 5 | Operand is an octaword.  |
| LIB\$K_DCFDYP_F = 6 | Operand is F_floating.   |
| LIB\$K_DCFDYP_D = 7 | Operand is D_floating.   |
| LIB\$K_DCFDYP_G = 8 | Operand is G_floating.   |
| LIB\$K_DCFDYP_H = 9 | Operand is H_floating.   |

Symbols of the form LIB\$K\_DCFOPR\_xy, where **x** is the access type and **y** is the data type, are also defined. These combine the notions of access and data type. For example, LIB\$K\_DCFOPR\_MF has the following value:

50 (2+(6\*8))

It denotes modify access of an F\_floating item. For the branch access type, only the types BB, BW, and BL are defined; otherwise, all combinations are available.

#### Call Format for a User Action Routine

LIB\$DECODE\_FAULT calls the user action routine when it finds an exception to be handled. Your user action routine handles the exception in any manner that you specify and then returns to LIB\$DECODE\_FAULT.

```
action-routine opcode ,instr-PC ,PSL ,registers ,operand-count
                ,operand-types ,read-operand-locations
                ,write-operand-locations ,signal-arguments
                ,signal-procedure ,context
                ,unspecified-user-argument ,original-registers
```

#### opcode

```
OpenVMS usage: longword_unsigned
type:          longword (unsigned)
access:       read only
mechanism:    by reference
```

## LIB\$ Routines

### LIB\$DECODE\_FAULT

Opcode of the instruction that caused the fault. The **opcode** argument is the address of a longword that contains this opcode. LIB\$DECODE\_FAULT supplies this opcode when it calls the user action routine.

For 2-byte opcodes, the escape code (for example, hex FD) is in the low-order byte. You must use this argument to examine the opcode instead of reading the bytes pointed to by **instr-PC**. This is because if a debugger breakpoint has been set on the instruction, only **opcode** contains the original instruction.

#### **instr-PC**

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Value of the PC for the instruction that caused the fault. The **instr-PC** argument is the address of a longword that contains the PC value.

Note the difference between this value and the contents of the **registers** array element that corresponds to the PC. R15 of the **registers** array element contains the address of the byte after the instruction that caused the fault.

#### **PSL**

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Processor status longword (PSL) at the time of the fault. The **PSL** argument is the address of a longword that contains this PSL. Your user action routine may modify this PSL within the restrictions of the VAX architecture.

#### **registers**

OpenVMS usage: vector\_longword\_unsigned  
type: longword (unsigned)  
access: modify  
mechanism: by reference, array reference

Contents of registers R0 through R15 (PC) at the time of the fault but after operand addressing-mode processing. This includes any autoincrements or autodecrements. The **registers** argument is the address of this 16-longword array. Each longword of the registers array contains the contents of one register.

Your user action routine may modify these values. If it does, the new values will be reflected when instruction execution continues.

To modify vector registers, execute a vector instruction. Executing a vector instruction in the handler modifies the state of the vector processor. The state of the vector processor is not restored when the handler returns. This has the effect of altering the state when the execution continues.

R15 denotes the sixteenth longword in the **registers** array, which corresponds to the PC. R15 contains the address of the next byte after the current instruction. Unless this value is modified by your user action routine, instruction execution will resume at that address. An exception is for the CASEB, CASEW, and CASEL instructions; R15 contains the address of the first displacement word. For these instructions, your user action routine must modify R15 to point to the next instruction to execute.

Upon instruction completion, registers R0-R15 are restored from this array. However, if **signal-procedure** is used to cause a fault or if instruction restart is specified by returning LIB\$\_RESTART, **original-registers** is used instead.

#### **operand-count**

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Number of operands in the instruction currently being decoded. The **operand-count** is the address of a longword that contains this number.

#### **operand-types**

OpenVMS usage: vector\_longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference, array reference

Array of longwords, one element for each operand, that contains the type codes for the associated operand. The **operand-types** argument is the address of this array.

The operand type codes are further defined in the section Instruction Operand Definition Codes, which appeared previously in this Description section.

#### **read-operand-locations**

OpenVMS usage: vector\_longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference, array reference

Array of longwords, one element for each operand, that contains the addresses of the operands to be read. The **read-operand-locations** argument is the address of this array.

The address given in the array may not be the actual address of the operand if the operand is not a memory location. If the operand is a register, the address indicates a copy of the register values at the time of operand evaluation. If the operand access type is ADDRESS or FIELD and the operand is not a register, the address is the address of the item. If the operand access type is FIELD and the operand is a register, the address refers to the appropriate element in the **registers** array. If the operand access type is BRANCH, the address is the destination PC of the branch. For WRITE access operands, the address value is zero.

#### **write-operand-locations**

OpenVMS usage: vector\_longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference, array reference

Array of longwords, one element for each operand, that contains the addresses of operands that are to be written. The **write-operand-locations** argument is the address of this array. If the operand access type is not MODIFY, WRITE, ADDRESS, or FIELD, the pointer value is zero.

## LIB\$ Routines

### LIB\$DECODE\_FAULT

#### signal-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference, array reference

Signal arguments list of the original exception, as passed from OpenVMS to your condition handler and then to LIB\$DECODE\_FAULT. The **signal-arguments** argument is the address of an array of longwords that contains these signal arguments.

#### signal-procedure

OpenVMS usage: procedure  
type: procedure value  
access: call without stack unwinding  
mechanism: by reference

Entry mask of a routine that your user action routine must call if it wants to report an exception for the instruction that faulted. The **signal-procedure** argument is the address of this entry mask.

For further information, see Call Format for a Signal Routine in the Description section.

#### context

OpenVMS usage: context  
type: unspecified  
access: read only  
mechanism: by value

Context in which the exception occurs, including the register and PSL contents, to be used when calling the signal-procedure. The **context** argument contains the value of this context.

#### unspecified-user-argument

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

Optional argument passed to LIB\$DECODE\_FAULT. If the argument was not specified, the value zero is substituted. The **unspecified-user-argument** argument contains the value of this optional argument.

#### original-registers

OpenVMS usage: vector\_longword\_unsigned  
type: longword (unsigned)  
access: modify  
mechanism: by reference, array reference

Array containing the values of registers R0 through R15 (PC) at the time of the fault, before operand processing. The **original-registers** argument is the address of this 16-longword array.

If the action routine specifies that the instruction should restart or that a fault should be generated, the registers are restored from **original-registers**. See also the description of **registers** above.

**Condition Values Returned from the User Action Routine** The user action routine can return the following condition values to LIB\$DECODE\_FAULT:

| Condition Value | Description   |
|-----------------|---|
| SS\$_CONTINUE   | If the user action routine returns a value of SS\$_CONTINUE, instruction execution will continue as specified by the current contents of the <b>registers</b> element for the PC.   |
| SS\$_RESIGNAL   | If the user action routine returns SS\$_RESIGNAL, the original exception is resignaled, with the only changes reflected being those specified by <b>registers</b> elements for R0 and R1 (which are stored in the mechanism arguments vector), PC, and PSL. All other registers are restored from original registers. |
| LIB\$_RESTART   | If the user action routine returns LIB\$_RESTART, the current instruction is restarted with registers restored from <b>original-registers</b> and a PSL from <b>PSL</b> . This feature is useful for writing trace handlers.  |

#### Call Format for a Signal Routine

Your action routine calls the signal routine using this format:

**signal-procedure** fault-flag ,context ,signal-arguments

#### fault-flag

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Longword flag whose low-order bit determines whether the exception is to be signaled as a fault or as a trap. The **fault-flag** argument contains the address of this longword.

If the low-order bit of **fault-flag** is set to 1, the exception is signaled as a fault. If the low-order bit of **fault-flag** is set to 0, the exception is signaled as a trap; the current contents of the **registers** array are used. In either case, the current contents of **PSL** are used to set the exception PSL.

#### context

OpenVMS usage: context  
 type: unspecified  
 access: read only  
 mechanism: by reference

Context in which the new exception is to occur, as passed to your user action routine by LIB\$DECODE\_FAULT. The **context** argument is the address of this context value.

#### signal-arguments

OpenVMS usage: arg\_list  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference, array reference

## LIB\$ Routines

### LIB\$DECODE\_FAULT

Signal arguments to be used. The **signal-arguments** argument is the address of an array of longwords that contains these signal arguments.

The first longword contains the number of following longwords; the remainder of the list contains signal names and arguments. Unlike the signal argument list passed to a condition handler, no PC or PSL is present.

Before the exception is signaled, the stack frames are unwound back to the original exception. You should be careful when causing a new signal that a loop of faults is not inadvertently generated. For example, the condition handler that called LIB\$DECODE\_FAULT will usually be called for the second signal. If the handler does not analyze the second signal as such, it may cycle through the identical path as for the first signal.

To resignal the current exception, have the user action routine return a value of SS\$\_RESIGNAL instead of calling the signal routine (unless you want previously called condition handlers to be called again).

### Condition Values Returned

SS\$\_RESIGNAL

Resignal condition to next handler. The exception described by **signal-arguments** was not an instruction fault handled by LIB\$DECODE\_FAULT. If LIB\$DECODE\_FAULT can process the fault, it does not return to its caller.

### Condition Value Signaled

LIB\$\_INVARG

Invalid argument to Run-Time Library. The instruction definition contained more than 16 operands or an operand definition contained an invalid data type or access code. This message is signaled after the stack frames have been unwound so that it appears to have been signaled from a routine that was called by the instruction that faulted.

### Example

The following Fortran example implements a simple recovery scheme for floating underflow and overflow faults, replacing the result of the instruction with the correctly signed, smallest possible value for underflows or largest possible value for overflows.

## LIB\$ Routines LIB\$DECODE\_FAULT

```

C+
C Example condition handler and user-action routine using
C LIB$DECODE_FAULT. This example demonstrates the use of
C most of the features of LIB$DECODE_FAULT. Its purpose
C is to handle floating underflow and overflow faults,
C replacing the result of the instruction with the correctly
C signed smallest possible value for underflows, or greatest
C possible value for overflows.
C
C For simplicity, faults involving the POLYx instructions are
C not handled.
C
C***
C FIXUP_RESULT is the condition handler enabled by the program
C desiring the fixup of overflows and underflows.
C***
C-

        INTEGER*4 FUNCTION FIXUP_RESULT(SIGARGS, MECHARGS)
        IMPLICIT NONE
        INCLUDE '($SSDEF)'           ! SS$ symbols
        INCLUDE '($LIBDCFDEF)'       ! LIB$DECODE_FAULT symbols
        INTEGER*4 SIGARGS(1:*)      ! Signal arguments list
        INTEGER*4 MECHARGS(1:*)     ! Mechanism arguments list

C+
C This is a sample redefinition of MULH3 instruction.
C-

        BYTE OPTABLE(8) /'FD'X,'65'X,      ! MULH3 opcode
        1          LIB$K_DCFOPR_RH,        ! Read H floating
        2          LIB$K_DCFOPR_RH,        ! Read H floating
        3          LIB$K_DCFOPR_WH,        ! Write H floating
        4          LIB$K_DCFOPR_END,      ! End of operands
        5          'FF'X,'FF'X/          ! End of instructions

        INTEGER*4 LIB$DECODE_FAULT      ! External function
        EXTERNAL FIXUP_ACTION          ! Action routine to do the fixup

C+
C Determine if the exception is one we want to handle.
C-

        IF ((SIGARGS(2) .EQ. SS$_FLTOVF_F) .OR.
        1  (SIGARGS(2) .EQ. SS$_FLTUND_F)) THEN

C+
C We think we can handle the fault. Call
C LIB$DECODE_FAULT and pass it the signal arguments and
C the address of our action routine and opcode table.
C-

        FIXUP_RESULT = LIB$DECODE_FAULT (SIGARGS,
        1  MECHARGS, %DESCR(FIXUP_ACTION),, OPTABLE)

        RETURN
        END IF

C+
C We can only get here if we couldn't handle the fault.
C Resignal the exception.
C-

        FIXUP_RESULT = SS$_RESIGNAL
        RETURN
        END

```

# LIB\$ Routines

## LIB\$DECODE\_FAULT

C+  
 C User action routine to handle the fault.  
 C-

```

INTEGER*4 FUNCTION FIXUP_ACTION (OPCODE, INSTR_PC, PSL,
1     REGISTERS, OP_COUNT,
2     OP_TYPES, READ_OPS,
3     WRITE_OPS, SIGARGS,
4     SIGNAL_ROUT, CONTEXT,
5     USER_ARG, ORIG_REGS)

IMPLICIT NONE
INCLUDE '($SSDEF)'           ! SS$ definitions
INCLUDE '($PSLDEF)'         ! PSL$ definitions
INCLUDE '($LIBDCFDEF)'      ! LIB$DECODE_FAULT
                             ! definitions

INTEGER*4 OPCODE             ! Instruction opcode
INTEGER*4 INSTR_PC          ! PC of this instruction
INTEGER*4 PSL               ! Processor status
                             ! longword

INTEGER*4 REGISTERS(0:15)   ! R0-R15 contents
INTEGER*4 OP_COUNT         ! Number of operands
INTEGER*4 OP_TYPES(1:*)    ! Types of operands
INTEGER*4 READ_OPS(1:*)   ! Addresses of read operands
INTEGER*4 WRITE_OPS(1:*)  ! Addresses of write operands
INTEGER*4 SIGARGS(1:*)    ! Signal argument list
INTEGER*4 SIGNAL_ROUT      ! Signal routine address
INTEGER*4 CONTEXT         ! Signal routine context
INTEGER*4 USER_ARG        ! User argument value
INTEGER*4 ORIG_REGS(0:15) ! Original registers

```

C+  
 C Declare and initialize table of class codes for each of the  
 C "real" opcodes. We'll index into this by the first byte of  
 C one-byte opcodes, the second byte of two-byte opcodes. The  
 C class codes will be used in a computed GOTO (CASE). The  
 C codes are:

- C 0 - Unsupported
- C 1 - ADD
- C 2 - SUB
- C 3 - MUL, DIV
- C 4 - ACB
- C 5 - CVT
- C 6 - EMOD

C The class mainly determines how we compute the sign of the  
 C result, except for ACB.

C-

```

BYTE INST_CLASS_TABLE(0:255)
DATA INST_CLASS_TABLE /
1     48*0,                               ! 00-2F
2     0,0,0,5,0,0,0,0,0,0,0,0,0,0,0,0,0, ! 30-3F
3     1,1,2,2,3,3,3,3,0,0,0,0,0,0,0,4,   ! 40-4F
4     0,0,0,0,6,0,0,0,0,0,0,0,0,0,0,0,   ! 50-5F
5     1,1,2,2,3,3,3,3,0,0,0,0,0,0,0,4,   ! 60-6F
6     0,0,0,0,6,0,5,0,0,0,0,0,0,0,0,0,   ! 70-7F
7     112*0,                               ! 80-EF
8     0,0,0,0,0,0,5,5,0,0,0,0,0,0,0,0/   ! F0-FF

```

C+  
 C Table of operand sizes in 8-bit bytes, indexed by the  
 C datatype code contained in the OP\_TYPES array. Only floating  
 C types matter.

C-

```

BYTE OP_SIZES(9) /0,0,0,0,0,4,8,8,16/

```

**LIB\$ Routines**  
**LIB\$DECODE\_FAULT**

```

INTEGER*4 LIB$EXTV           ! External function
INTEGER*4 RESULT_NEGATIVE   ! -1 if result negative,
                             ! 0 if positive

INTEGER*4 SIGN1,SIGN2,SIGN3 ! Signs of operands
INTEGER*4 INST_BYTE         ! Current opcode byte
INTEGER*4 INST_CLASS        ! Class of instruction
                             ! from table

INTEGER*4 OP_DTYPE          ! Datatype of operand
INTEGER*4 OP_SIZE           ! Size of operand in
                             ! 8-bit bytes

INTEGER*4 RESULT_OP         ! Position of result
                             ! in WRITE OPS array

LOGICAL*4 OVERFLOW          ! TRUE if SS$ FLTOVF_F
LOGICAL*4 SMALLER           ! Function which
                             ! compares operands

PARAMETER ESCD = '0FD'X     ! First byte of G,H instructions

INTEGER*2 SMALL_F(2)        ! Smallest F_floating
DATA SMALL_F /'0080'X,0/
INTEGER*2 SMALL_D(4)        ! Smallest D_floating
DATA SMALL_D /'0080'X,0,0,0/
INTEGER*2 SMALL_G(4)        ! Smallest G_floating
DATA SMALL_G /'0010'X,0,0,0/
INTEGER*2 SMALL_H(8)        ! Smallest H_floating
DATA SMALL_H /'0001'X,0,0,0,0,0,0,0/
INTEGER*2 BIGGEST(8)        ! Biggest value (all datatypes)
DATA BIGGEST /'7FFF'X,7*'FFFF'X/

INTEGER*4 SIGNAL_ARRAY(2)   ! Array for signalling new
                             ! exception

```

C+

C

C NOTE: Because the operands arrays contain the locations of  
C the operands, rather than the operands themselves,  
C we must call a routine using the %VAL function to  
C "fool" the called routine into considering the  
C contents of an operands array element as the address  
C of an item. This would not be necessary in a  
C language that understood the concept of pointer  
C variables, such as PASCAL.

C

C

C If FPD is set in the PSL, signal SS\$\_ROPRAND (reserved operand). In  
C reality this shouldn't happen since none of the instructions we  
C handle can set FPD, but do it as an example.

C-

```

IF (BTEST(PSL,PSL$V_FPD)) THEN
  SIGNAL_ARRAY(1) = 1         ! Count of signal arguments
  SIGNAL_ARRAY(2) = SS$_ROPRAND ! Error status value
  CALL SIGNAL_ROUT (
1     1,                       ! Fault flag - signal as fault
2     SIGNAL_ARRAY,           ! Signal arguments array
3     CONTEXT)                ! Context as passed to us
                             ! Call will never return
END IF

```

C+

C Set OVERFLOW according to the exception type. We assume that  
C the only alternatives are SS\$\_FLTOVF\_F and SS\$\_FLTUND\_F.

C-

```

OVERFLOW = (SIGARGS(2) .EQ. SS$_FLTOVF_F)

```

# LIB\$ Routines

## LIB\$DECODE\_FAULT

```

C+
C Determine the datatype of the instruction by that of its
C second operand, since that is always the type of the
C destination.
C-
        OP_DTYPE = IBITS(OP_TYPES(2),LIB$V_DCFTYP,LIB$$_DCFTYP)

C+
C Get the size of the datatype in words.
C-
        OP_SIZE = OP_SIZES (OP_DTYPE)

C+
C Determine the class of instruction and dispatch to the
C appropriate routine.
C-
        INST_BYTE = IBITS(OPCODE,0,8) ! Get first byte
        IF (INST_BYTE .EQ. ESCD) INST_BYTE = IBITS(OPCODE,8,8)
        INST_CLASS = INST_CLASS_TABLE(INST_BYTE)
        GO TO (1000,2000,3000,4000,5000,6000),INST_CLASS

C+
C If we get here, the instruction's entry in the
C INST_CLASS_TABLE is zero. This might happen if the instruction was
C a POLYx, or was some other unsupported instruction. Resignal the
C original exception.
C-
        FIXUP_ACTION = $$$_RESIGNAL ! Resignal condition to next handler
        RETURN ! Return to LIB$DECODE_FAULT

C+
C 1000 - ADDF2, ADDF3, ADDD2, ADDD3, ADDG2, ADDG3, ADDH2, ADDH3
C
C Result's sign is the same as that of the first operand,
C unless this is an underflow, in which case the magnitudes of
C the values may change the sign.
C-
1000  RESULT_NEGATIVE = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
      IF (.NOT. OVERFLOW) THEN
        IF (SMALLER(OP_SIZE,%VAL(READ_OPS(1)),
1          %VAL(READ_OPS(2))))
2      RESULT_NEGATIVE = .NOT. RESULT_NEGATIVE
      END IF
      GO TO 9000

C+
C 2000 - SUBF2, SUBF3, SUBD2, SUBD3, SUBG2, SUBG3, SUBH2, SUBH3
C
C Result's sign is the opposite of that of the first operand,
C unless this is an underflow, in which case the magnitudes of
C the values may change the sign.
C-
2000  RESULT_NEGATIVE = .NOT. LIB$EXTV (15,1,%VAL(READ_OPS(1)))
      IF (.NOT. OVERFLOW) THEN
        IF (SMALLER(OP_SIZE,%VAL(READ_OPS(1)),
1          %VAL(READ_OPS(2))))
2      RESULT_NEGATIVE = .NOT. RESULT_NEGATIVE
      END IF
      GO TO 9000

```

**LIB\$ Routines**  
**LIB\$DECODE\_FAULT**

```

C+
C 3000 - MULF2, MULF3, MULD2, MULD3, MULG2, MULG3, MULH2, MULH3,
C         DIVF2, DIVF3, DIVD2, DIVD3, DIVG2, DIVG3, DIVH2, DIVH3,
C
C If the signs of the first two operands are the same, then the
C result's sign is positive, if they are not it is negative.
C-
3000  SIGN1 = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
      SIGN2 = LIB$EXTV (15,1,%VAL(READ_OPS(2)))
      RESULT_NEGATIVE = SIGN1 .XOR. SIGN2
      GOTO 9000

C+
C 4000 - ACBF, ACBD, ACBG, ACBH
C
C The result's sign is the same as that of the second operand
C (addend), unless this is underflow, in which case the
C magnitudes of the addend and index may change the sign.
C We must also determine if the branch is to be taken.
C-
4000  SIGN2 = LIB$EXTV (15,1,%VAL(READ_OPS(2)))
      RESULT_NEGATIVE = SIGN2
      IF (.NOT. OVERFLOW) THEN
        IF (SMALLER(OP_SIZE,%VAL(READ_OPS(2)),
          1      %VAL(READ_OPS(3))))
          2  RESULT_NEGATIVE = .NOT. RESULT_NEGATIVE
      END IF

C+
C If this is overflow, then the branch is not taken, since the
C result is always going to be greater or equal in magnitude
C to the limit, and will be the correct sign. If underflow,
C the branch is ALMOST always taken. The only case where the
C branch might not be taken is when the result is exactly
C equal to the limit. For this example, we are going to ignore
C this exceptional case.
C-
      IF (.NOT. OVERFLOW)
        1  REGISTERS(15) = READ_OPS(4) ! Branch destination
        GO TO 9000

C+
C 5000 - CVTDF, CVTGF, CVTHF, CVTHD, CVTHG
C
C Result's sign is the same as that of the first operand.
C-
5000  RESULT_NEGATIVE = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
      GO TO 9000

C+
C 6000 - EMOF, EMOF, EMOF, EMOF
C
C If the signs of the first and third operands are the same, then the
C result's sign is positive, else it is negative.
C-
6000  SIGN1 = LIB$EXTV (15,1,%VAL(READ_OPS(1)))
      SIGN2 = LIB$EXTV (15,1,%VAL(READ_OPS(3)))
      RESULT_NEGATIVE = SIGN1 .XOR. SIGN2
      GOTO 9000

```

**LIB\$ Routines**  
**LIB\$DECODE\_FAULT**

```

C+
C All code paths merge here to store the result value. We also
C set the PSL appropriately. First, determine which operand is
C the result.
C-

9000 RESULT_OP = OP_COUNT
      IF (INST_CLASS.EQ. 4)
          1 RESULT_OP = RESULT_OP - 1 ! ACBx

C+
C Select result based on datatype and exception type.
C-

      IF (OVERFLOW) THEN
          CALL LIB$MOVC3 (OP_SIZE,BIGGEST,%VAL(WRITE_OPS(RESULT_OP)))
      ELSE
          GO TO (9100,9200,9300,9400), OP_DTYPE-(LIB$K_DCFTYP_F-1)

C+
C Should never get here. Resignal original exception.
C-

          FIXUP ACTION = SS$_RESIGNAL
          RETURN

C+
C 9100 - F_floating result
C-

9100 CALL LIB$MOVC3 (OP_SIZE,SMALL_F,%VAL(WRITE_OPS(RESULT_OP)))
      GOTO 9500

C+
C 9200 - D_floating result
C-

9200 CALL LIB$MOVC3 (OP_SIZE,SMALL_D,%VAL(WRITE_OPS(RESULT_OP)))
      GOTO 9500

C+
C 9300 - G_floating result
C-

9300 CALL LIB$MOVC3 (OP_SIZE,SMALL_G,%VAL(WRITE_OPS(RESULT_OP)))
      GOTO 9500

C+
C 9400 - H_floating result
C-

9400 CALL LIB$MOVC3 (OP_SIZE,SMALL_H,%VAL(WRITE_OPS(RESULT_OP)))
      GOTO 9500

9500 END IF

C+
C Modify the PSL to reflect the stored result. If the result was
C negative, set the N bit. Clear the V (overflow) and Z (zero) bits.
C If the instruction was an ACBx, leave the C (carry) bit unchanged,
C otherwise clear it.
C-

      IF (RESULT_NEGATIVE) THEN
          PSL = IB$SET (PSL,PSL$V_N) ! Set N bit
      ELSE

```

**LIB\$ Routines**  
**LIB\$DECODE\_FAULT**

```

        PSL = IBCLR (PSL,PSL$V_N)      ! Clear N bit
    END IF
    PSL = IBCLR (PSL,PSL$V_V)          ! Clear V bit
    PSL = IBCLR (PSL,PSL$V_Z)          ! Clear Z bit
    IF (INST_CLASS .NE. 4)
    1 PSL = IBCLR (PSL,PSL$V_C)          ! Clear C bit if not ACBx

C+
C  Set the sign of result.
C-

        IF (RESULT NEGATIVE)
    1 CALL LIB$INSV (1,15,1,%VAL(WRITE_OPS(RESULT_OP)))

C+
C  Fixup is complete.  Return to LIB$DECODE_FAULT.
C-

        FIXUP_ACTION = SS$_CONTINUE
        RETURN
    END

C+
C  Function which compares two floating values.  It returns .TRUE. if
C  the first argument is smaller in magnitude than the second.
C-

        LOGICAL*4 FUNCTION SMALLER(NBYTES,VAL1,VAL2)

        INTEGER*4 NBYTES                ! Number of bytes in values
        INTEGER*2 VAL1(*),VAL2(*)        ! Floating values to compare
        INTEGER*4 WORDA,WORDB

        SMALLER = .TRUE.                ! Initially return true

C+
C  Zero extend to a longword for unsigned compares.
C  Compare first word without sign bit.
C-

        WORDA = IBCLR(ZEXT(VAL1(1)),15)
        WORDB = IBCLR(ZEXT(VAL2(1)),15)
        IF (WORDA .LT. WORDB) RETURN

        DO I=2,NBYTES/2
        WORDA = ZEXT(VAL1(I))
        WORDB = ZEXT(VAL2(I))
        IF (WORDA .LT. WORDB) RETURN
        END DO

        SMALLER = .FALSE.                ! VAL1 not smaller than VAL2
        RETURN
    END

```

---

## LIB\$DEC\_OVER

### Enable or Disable Decimal Overflow Detection

The Enable or Disable Decimal Overflow Detection routine enables or disables decimal overflow detection for the calling routine activation. The previous decimal overflow setting is returned.†

**Alpha**

This routine is available on OpenVMS Alpha systems in translated form and is applicable to translated VAX images only. ♦

#### Format

LIB\$DEC\_OVER new-setting

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword integer (unsigned)  
access: write only  
mechanism: by value

The old decimal overflow enable setting (the previous contents of SF\$W\_PSW[PSW\$V\_DV] in the caller's frame).

#### Argument

**new-setting**  
OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

New decimal overflow enable setting. The **new-setting** argument is the address of an unsigned longword that contains the new decimal overflow enable setting. Bit 0 set to 1 means enable; bit 0 set to 0 means disable.

#### Description

The caller's stack frame is modified by this routine.

A call to LIB\$DEC\_OVER affects only the current routine activation and does not affect any of its callers or any routines that it may call. However, the setting does remain in effect for any routines that are subsequently entered through a JSB entry point.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Example

```

DECOVF: ROUTINE OPTIONS (MAIN);
DECLARE LIB$DEC_OVER ENTRY (FIXED BINARY (7)) /* Address of byte for
/* enable/disable
/* setting */
        RETURNS (FIXED BINARY (31));        /* Old setting */
DECLARE DISABLE FIXED BINARY (7) INITIAL (0) STATIC READONLY;
DECLARE RESULT FIXED BINARY (31);
DECLARE (A,B) FIXED DECIMAL (4,2);
ON FIXEDOVERFLOW PUT SKIP LIST ('Overflow');
RESULT = LIB$DEC_OVER (DISABLE);           /* Disable recognition of decimal
/* overflow in this block */
A = 99.99;
B = A + 2;
PUT SKIP LIST ('In MAIN');
BEGIN;
B = A + 2;
PUT LIST ('In BEGIN block');
CALL Q;
        Q: ROUTINE;
        B = A + 2;
        PUT LIST ('In Q');
        END Q;
        END /* Begin */;
END DECOVF;

```

This PL/I program shows how to use LIB\$DEC\_OVER to enable or disable the detection of decimal overflow. Note that in PL/I, disabling decimal overflow using this routine causes the condition to be disabled only in the current block; descendent blocks will enable the condition unless this routine is called in each block.

---

## LIB\$DELETE\_FILE

### Delete One or More Files

The Delete One or More Files routine deletes one or more files. The specification of the files to be deleted may include wildcards.

LIB\$DELETE\_FILE is similar in function to the DCL command DELETE.

#### Format

```
LIB$DELETE_FILE filespec [,default-filespec] [,related-filespec] [,user-success-procedure]
                [,user-error-procedure] [,user-confirm-procedure] [,user-specified-argument]
                [,resultant-name] [,file-scan-context]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String containing the OpenVMS Record Management Services (RMS) file specification of the files to be deleted. The **filespec** argument is the address of a descriptor pointing to the file specification. If the specification includes wildcards, each file that matches the specification is deleted. The string must not contain more than 255 characters. Any string class is supported.

##### default-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Default file specification of the files to be deleted. The **default-filespec** argument is the address of a descriptor pointing to the default file specification. This is an optional argument; if the argument is omitted, the default is the null string. Any string class is supported.

See the *OpenVMS Record Management Services Reference Manual* for information about default file specifications.

##### related-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Related file specification of the files to be deleted. The **related-filespec** argument is the address of a descriptor pointing to the related file specification. Any string

class is supported. This is an optional argument; if the argument is omitted, the default is the null string.

Input file parsing is used. See the *OpenVMS Record Management Services Reference Manual* for information on related file specifications and input file parsing.

The related file specification is useful when you are processing lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed.

#### **user-success-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied success routine that LIB\$DELETE\_FILE calls after it successfully deletes a file.

The success routine can be used to display a log of the files that were deleted. For more information on the success routine, look under Call Format for a Success Routine in the Description section.

#### **user-error-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied error routine that LIB\$DELETE\_FILE calls when it detects an error.

The error routine returns a success/fail value that LIB\$DELETE\_FILE uses to determine if more files should be processed. For more information on the error routine, see Call Format for an Error Routine in the Description section.

#### **user-confirm-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied confirm routine that LIB\$DELETE\_FILE calls before each file is deleted. The value returned by the confirm routine determines whether or not the file will be deleted. The confirm routine can be used to select specific files for deletion based on criteria such as expiration date, size, and so on.

For more information about the confirm routine, see Call Format for a Confirm Routine in the Description section.

#### **user-specified-argument**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

User-supplied argument that LIB\$DELETE\_FILE passes to the error, success, and confirm routines each time they are called. Whatever mechanism is used to

## LIB\$ Routines

### LIB\$DELETE\_FILE

pass **user-specified-argument** to LIB\$DELETE\_FILE is also used to pass it to the routines. This is an optional argument; if the argument is omitted, zero is passed by value.

#### resultant-name

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String into which LIB\$DELETE\_FILE writes the RMS resultant file specification of the last file processed. The **resultant-name** argument is the address of a descriptor pointing to the resultant name.

If present, **resultant-name** is used to store the file specification passed to the user-supplied routines, instead of a default class S, type T string. Therefore, this argument should be specified when the user-supplied routines are used and those routines require a descriptor type other than class S, type T. Any string class is supported.

If you specify one or more of the user-supplied action routines, the descriptor used to pass **resultant-name** must be:

- Of the same class as the descriptor required by the **filespec** argument of any action routines. For example, VAX Ada requires a class SB descriptor for string arguments to Ada routines but will use a class A descriptor by default when calling external routines. Refer to your language manual to determine the proper descriptor class to use.
- Of the same form as the descriptor required by the **filespec** argument of all action routines. For example, if the **filespec** argument of an action routines uses a 64-bit descriptor then the **resultant-name** argument must also use a 64-bit descriptor. ♦

Alpha

#### file-scan-context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context for deleting a list of file specifications. The **file-scan-context** argument is the address of a longword containing the context value.

You must initialize the file scan context to zero before the first of a series of calls to LIB\$DELETE\_FILE. LIB\$FILE\_SCAN uses this context to retain the file context for multiple input files. You must specify this context only when you are dealing with multiple input files, as the DCL command DELETE does. You may deallocate the context allocated by LIB\$FILE\_SCAN by calling LIB\$FILE\_SCAN\_END after all calls to LIB\$DELETE\_FILE have been completed.

## Description

This Description section is divided into three parts:

- Call Format for a Success Routine
- Call Format for an Error Routine
- Call Format for a Confirm Routine

### Call Format for a Success Routine

The success routine is called only if the **user-success-procedure** argument was specified in the LIB\$DELETE\_FILE argument list.

The calling format of a success routine is as follows:

**user-success-procedure** filespec [,user-specified-argument]

#### filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Record Management Services (RMS) resultant file specification of the file being deleted. The **filespec** argument is the address of a descriptor pointing to the file specification. If the **resultant-name** argument was specified, it is used to pass the string to the success routine. Otherwise, a class S, type T string is passed. Any string class is supported.

Alpha

The descriptor specified by each of the action routines for the **filespec** argument and the descriptor specified by the LIB\$DELETE\_FILE **resultant-name** argument, if any, must be of the same form. They must all be 32-bit descriptors or all 64-bit descriptors. If you do not specify a **resultant-name** argument, then the **filespec** argument must use a 32-bit descriptor. ♦

#### user-specified-argument

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: unspecified

Value of **user-specified-argument** passed by LIB\$DELETE\_FILE to the success routine. The same passing mechanism that was used to pass **user-specified-argument** to LIB\$DELETE\_FILE is used by LIB\$DELETE\_FILE to pass **user-specified-argument** to the success routine. This is an optional argument.

### Call Format for an Error Routine

The error routine is called only if the **user-error-procedure** argument was specified in the LIB\$DELETE\_FILE argument list.

The calling format of an error routine is as follows:

**user-error-procedure** filespec ,rms-sts ,rms-stv ,error-source [,user-specified-argument]

#### filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String containing the RMS resultant file specification of the file being deleted. If **resultant-name** was specified, it is used to pass the string to the error routine. Otherwise, a class S, type T string is passed. Any string class is supported.

## LIB\$ Routines

### LIB\$DELETE\_FILE

Alpha

The descriptor specified by each of the action routines for the **filespec** argument and the descriptor specified by the **LIB\$DELETE\_FILE resultant-name** argument, if any, must be of the same form. They must all be 32-bit descriptors or all 64-bit descriptors. If you specify no **resultant-name** argument then the **filespec** argument must use a 32-bit descriptor. ♦

#### rms-sts

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Primary condition code (FAB\$L\_STS) that describes the error that occurred. The **rms-sts** argument is the address of an unsigned longword that contains the primary condition code.

#### rms-stv

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Secondary condition code (FAB\$L\_STV) that describes the error that occurred. The **rms-stv** argument is the address of an unsigned longword that contains the secondary condition code.

#### error-source

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Integer code that indicates the point at which the error was found. The **error-source** argument is the address of a longword integer containing the code of the error source.

Possible values for the error code are as follows:

- 0 Error searching for file specification
- 1 Error deleting file

#### user-specified-argument

OpenVMS usage: user\_arg  
type: unspecified  
access: read only  
mechanism: unspecified

Value passed to **LIB\$DELETE\_FILE** that is then passed to **user-error-procedure** using the same passing mechanism that was used to pass it to **LIB\$DELETE\_FILE**. This is an optional argument.

If the error routine returns a success status (bit 0 set), then **LIB\$DELETE\_FILE** continues processing files. If a failure status (bit 0 clear) is returned, then processing ceases immediately, and **LIB\$DELETE\_FILE** returns with the error status.

If the **user-error-procedure** argument is not specified, LIB\$DELETE\_FILE returns to its caller the most severe error status encountered while deleting the files. If the error routine is called for an error, the success status LIB\$\_ERRROUCAL is returned.

The error routine is not called for errors related to string copying.

#### Call Format for a Confirm Routine

The confirm routine is called only if the **user-confirm-procedure** argument was specified in the call to LIB\$DELETE\_FILE.

The calling format of the confirm routine is as follows:

**user-confirm-procedure** filespec ,fab [,user-specified-argument]

#### filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

RMS resultant file specification of the file to be deleted. The **filespec** argument is the address of a descriptor pointing to the file specification.

If **resultant-name** was specified, it is used to pass the string to the confirm routine. Otherwise, a class S, type T string is passed. Any string class is supported.

Alpha

The descriptor specified by each of the action routines for the **filespec** argument and the descriptor specified by the LIB\$DELETE\_FILE **resultant-name** argument, if any, must be of the same form. They must all be 32-bit descriptors or all 64-bit descriptors. If you do not specify a **resultant-name** argument then the **filespec** argument must use a 32-bit descriptor. ♦

#### fab

OpenVMS usage: fab  
type: unspecified  
access: read only  
mechanism: by reference

RMS file access block (FAB) that describes the file being deleted. Your program may perform an RMS \$OPEN on the FAB to obtain file attributes to determine whether the file should be deleted, but it must close the file with \$CLOSE before returning to LIB\$DELETE\_FILE.

#### user-specified-argument

OpenVMS usage: user\_arg  
type: unspecified  
access: read only  
mechanism: unspecified

The value of the **user-specified-argument** argument that LIB\$DELETE\_FILE passes to the confirm routine using the same passing mechanism that was used to pass it to LIB\$DELETE\_FILE. This is an optional argument.

If confirm routine returns a success status (bit 0 set), the file is then deleted; otherwise, the file is not deleted.

## LIB\$ Routines

### LIB\$DELETE\_FILE

#### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_ERRROUCAL | Success, but an error routine was called. A file error was encountered, but the error routine was called to handle the condition. |
| LIB\$_INVFILSPE | Invalid file specification. <b>Filespec</b> or <b>default-filespec</b> is longer than 255 characters.                             |
| LIB\$_INVSTRDES | Invalid string descriptor. The descriptor for a string argument was not a valid string descriptor.                                |
| LIB\$_WRONUMARG | Wrong number of arguments. An incorrect number of arguments was passed to LIB\$DELETE_FILE.                                       |

Any condition value returned by LIB\$SCOPY\_xxx except those condition values specifying truncation errors.

Any condition value returned by RMS. If **user-error-procedure** is not specified, this is the most severe of the RMS errors encountered while deleting the files.

#### Example

```
PROGRAM DELETE_EXAMPLE(INPUT, OUTPUT);

{+}
{ Declare external function LIB$DELETE_FILE. Throughout this
{ example, the user-arg argument is not used.
{-}

FUNCTION LIB$DELETE_FILE(
    FILESPEC: VARYING [A] OF CHAR;
    DEFAULT_FILESPEC: VARYING [B] OF CHAR;
    REL_FILESPEC : VARYING [D] OF CHAR;
    %IMMED [UNBOUND] ROUTINE SUCCESS ROUTINE
        (FILESPEC : VARYING [A] OF CHAR) := %IMMED 0;
    %IMMED [UNBOUND] FUNCTION ERROR ROUTINE
        (FILESPEC : VARYING [A] OF CHAR; RMS_STS, RMS_STV : INTEGER)
        : BOOLEAN := %IMMED 0;
    %IMMED [UNBOUND] FUNCTION CONFIRM ROUTINE
        (FILESPEC: VARYING [A] OF CHAR): BOOLEAN := %IMMED 0;
    VAR USER_ARG : [UNSAFE] INTEGER := %IMMED 0;
    VAR RESULT_NAME : VARYING [C] OF CHAR := %IMMED 0
) : INTEGER; EXTERN;

{+}
{ Declare a routine which will display the names of the files
{ as they are deleted.
{-}

ROUTINE LOG_ROUTINE(FILESPEC : VARYING [A] OF CHAR);
    BEGIN
        WRITELN('File ', FILESPEC, ' successfully deleted');
    END;

{+}
{ Declare a routine which will notify the user that an error
{ occurred.
{-}
```

**LIB\$ Routines  
LIB\$DELETE\_FILE**

```
FUNCTION ERR_ROUTINE(FILESPEC: VARYING [A] OF CHAR;  
  RMS_STS, RMS_STV: INTEGER): BOOLEAN;  
  BEGIN  
    WRITELN('Delete of ', FILESPEC, ' failed ', HEX(RMS_STS));  
    ERR_ROUTINE := TRUE;  
  END;  
  
{+}  
{ Declare a routine which checks to see if the file should be  
{ deleted. If the filename contains the string 'XYZ', then it is  
{ deleted.  
{-}  
  
FUNCTION CONFIRM_ROUTINE( FILESPEC: VARYING [A] OF CHAR): BOOLEAN;  
  BEGIN  
    IF INDEX(FILESPEC, 'XYZ') <> 0  
    THEN  
      CONFIRM_ROUTINE := TRUE  
    ELSE  
      CONFIRM_ROUTINE := FALSE;  
    END;  
  
{+}  
{ The main program begins here.  
{-}  
  
VAR  
  FILES_TO_DELETE, RESULTANT_NAME : VARYING [255] OF CHAR;  
  RET_STATUS : INTEGER;  
  
BEGIN  
  WRITE ('Files to delete: ');  
  READLN(FILES_TO_DELETE);  
  RET_STATUS := LIB$DELETE_FILE(  
    FILES_TO_DELETE, '*', ' ', LOG_ROUTINE, ERR_ROUTINE,  
    CONFIRM_ROUTINE, RESULTANT_NAME);  
  IF NOT ODD(RET_STATUS)  
  THEN  
    WRITELN('Delete failed. The error was ', HEX(RET_STATUS));  
END.
```

This Pascal program prompts the user for file specifications of files to be deleted. Of those, it deletes only files that contain the string XYZ somewhere in their resultant file specification. The names of deleted files are displayed.

---

## LIB\$DELETE\_LOGICAL

### Delete Logical Name

The Delete Logical Name routine requests the calling process' command language interpreter (CLI) to delete a supervisor-mode process logical name. LIB\$DELETE\_LOGICAL provides the same function as the DCL command DEASSIGN.

#### Format

LIB\$DELETE\_LOGICAL logical-name [,table-name]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### logical-name

OpenVMS usage: logical\_name  
type: character string  
access: read only  
mechanism: by descriptor

Logical name to be deleted. The **logical-name** argument is the address of a descriptor pointing to this logical name string. The maximum length of a logical name is 255 characters.

##### table-name

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name of the table from which the logical name is to be deleted. The **table-name** argument is the address of a descriptor pointing to this name string. This is an optional argument. If the argument is omitted, the LNM\$PROCESS table is used.

#### Description

LIB\$DELETE\_LOGICAL requests the calling process's command language interpreter (CLI) to delete a supervisor-mode process logical name. If the optional **table-name** argument is defined, the logical name is deleted from that table. Otherwise, the logical name is deleted from the LNM\$PROCESS table.

Unlike the system service \$DELLOG and \$DELLNM, LIB\$DELETE\_LOGICAL does not require the caller to be executing in supervisor mode to delete a supervisor-mode logical name.

This routine is supported for use with the DCL and MCR command language interpreters.

This routine does not support the DCL DEFINE and DEASSIGN commands' special side effect of opening and closing a process-permanent file if the logical name "SYS\$OUTPUT" is specified.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In that case, the error status LIB\$\_NOCLI is returned.

See the *OpenVMS DCL Dictionary* for a description of the DCL command DEASSIGN.

### Condition Values Returned

|                  |  |
|------------------|--|
| SS\$_ACCVIO      | Access violation. The logical name could not be read.  |
| SS\$_IVLOGNAM    | Invalid logical name. The logical name contained illegal characters or more than 255 characters.   |
| SS\$_IVLOGTAB    | Invalid logical name table   |
| SS\$_NOLOGNAM    | No logical name match. The logical name was not defined as a supervisor-mode process logical name.   |
| SS\$_NOPRIV      | No privilege for attempted operation.  |
| SS\$_NORMAL      | Routine successfully completed.  |
| SS\$_TOOMANYLNAM | Logical name translation exceeded allowed depth.   |
| LIB\$_INVSTRDES  | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |
| LIB\$_NOCLI      | No CLI present to perform function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.   |
| LIB\$_UNECLIERR  | Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to Digital by means of a Software Performance Report (SPR). |

---

## LIB\$DELETE\_SYMBOL

### Delete CLI Symbol

The Delete CLI Symbol routine requests the calling process's command language interpreter (CLI) to delete an existing CLI symbol.

#### Format

LIB\$DELETE\_SYMBOL symbol [,table-type-indicator]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### symbol

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name of the symbol to be deleted by LIB\$DELETE\_SYMBOL. The **symbol** argument is the address of a descriptor pointing to this symbol string. The symbol name is converted to uppercase, and trailing blanks are removed before use.

**Symbol** must begin with a letter, a digit, a dollar sign (\$), a hyphen (-), or an underscore (\_). The maximum length of **symbol** is 255 characters.

##### table-type-indicator

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Indicator of the table that contains the symbol to be deleted. The **table-type-indicator** argument is the address of a signed longword integer that is this table indicator.

If **table-type-indicator** is omitted, the local symbol table is used. The following are possible values for the **table-type-indicator** argument:

---

| Symbolic Name         | Value | Table Used          |
|-----------------------|-------|---------------------|
| LIB\$K_CLI_LOCAL_SYM  | 1     | Local symbol table  |
| LIB\$K_CLI_GLOBAL_SYM | 2     | Global symbol table |

---

## Description

LIB\$DELETE\_SYMBOL is supported for use with the DCL CLI. The error status LIB\$\_NOCLI is returned if LIB\$DELETE\_SYMBOL is used with the MCR CLI or called from an image run directly as a subprocess or as a detached process.

LIB\$K\_CLI\_LOCAL\_SYM and LIB\$K\_CLI\_GLOBAL\_SYM are defined in Digital-supplied symbol libraries (macro or module name \$LIBCLIDEF) and as global symbols.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital.  |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVARG    | Invalid argument. The value of <b>table-type-indicator</b> was invalid.  |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |
| LIB\$_INVSYMNAM | Invalid symbol name. The symbol name contained more than 255 characters or did not begin with a letter, a digit, a dollar sign, a hyphen, or an underscore.  |
| LIB\$_NOCLI     | No CLI present to perform the function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.   |
| LIB\$_NOSUCHSYM | No such symbol. The symbol was not defined.  |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to Digital by means of a Software Performance Report (SPR). |

---

## LIB\$DELETE\_VM\_ZONE

### Delete Virtual Memory Zone

The Delete Virtual Memory Zone routine deletes a zone from the 32-bit virtual address space and returns all pages on VAX systems or pagelets on Alpha systems owned by the zone to the processwide 32-bit page pool.†

#### Format

LIB\$DELETE\_VM\_ZONE zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**zone-id**  
OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier. The **zone-id** is the address of a longword that contains the identifier of a zone created by a previous call to LIB\$CREATE\_VM\_ZONE or LIB\$CREATE\_USER\_VM\_ZONE.

#### Description

LIB\$DELETE\_VM\_ZONE deletes a zone and returns all pages on VAX systems or pagelets on Alpha systems owned by the zone to the processwide pool managed by LIB\$GET\_VM\_PAGE. The pages or pagelets are then available for reallocation by later calls to LIB\$GET\_VM or LIB\$GET\_VM\_PAGE.

It takes less time to free memory in a single operation by calling LIB\$DELETE\_VM\_ZONE than to individually account for and free every block of memory that was allocated by calling LIB\$GET\_VM.

You must ensure that your program is no longer using any of the memory in the zone before you call LIB\$DELETE\_VM\_ZONE. Your program must not do any further operations on the zone after you call LIB\$DELETE\_VM\_ZONE.

If you specified deallocation filling when you created the zone, LIB\$DELETE\_VM\_ZONE will fill all of the allocated blocks that are freed.

If the zone you are deleting was created using the LIB\$CREATE\_USER\_VM\_ZONE routine, then you must have an appropriate action routine for the delete operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE, you must have specified a **user-delete-procedure**.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_BADBLOADR

An invalid **zone-id** argument or a corrupted zone.

## LIB\$ Routines

### LIB\$DELETE\_VM\_ZONE\_64 (Alpha Only)

---

## LIB\$DELETE\_VM\_ZONE\_64 (Alpha Only)

### Delete Virtual Memory Zone

The Delete Virtual Memory Zone routine deletes a zone from the 64-bit virtual address space and returns all Alpha system pagelets owned by the zone to the processwide 64-bit page pool.

#### Format

LIB\$DELETE\_VM\_ZONE\_64 zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**zone-id**  
OpenVMS usage: identifier  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier. The **zone-id** is the address of a quadword that contains the identifier of a zone created by a previous call to LIB\$CREATE\_VM\_ZONE\_64 or LIB\$CREATE\_USER\_VM\_ZONE\_64.

#### Description

LIB\$DELETE\_VM\_ZONE\_64 deletes a zone and returns all pagelets on Alpha systems owned by the zone to the processwide pool managed by LIB\$GET\_VM\_PAGE\_64. The pagelets are then available for reallocation by later calls to LIB\$GET\_VM\_64 or LIB\$GET\_VM\_PAGE\_64.

It takes less time to free memory in a single operation by calling LIB\$DELETE\_VM\_ZONE\_64 than to individually account for and free every block of memory that was allocated by calling LIB\$GET\_VM\_64.

You must ensure that your program is no longer using any of the memory in the zone before you call LIB\$DELETE\_VM\_ZONE\_64. Your program must not do any further operations on the zone after you call LIB\$DELETE\_VM\_ZONE\_64.

If you specified deallocation filling when you created the zone, LIB\$DELETE\_VM\_ZONE\_64 will fill all of the allocated blocks that are freed.

If the zone you are deleting was created using the LIB\$CREATE\_USER\_VM\_ZONE\_64 routine, then you must have an appropriate action routine for the delete operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE\_64, you must have specified a **user-delete-procedure**.

**LIB\$ Routines**  
**LIB\$DELETE\_VM\_ZONE\_64 (Alpha Only)**

**Condition Values Returned**

SS\$\_NORMAL  
LIB\$\_BADBLOADR

Routine successfully completed.  
An invalid **zone-id** argument or a corrupted zone.

---

## LIB\$DIGIT\_SEP

### Get Digit Separator Symbol

The Get Digit Separator Symbol routine returns the system's digit separator symbol.

#### Format

LIB\$DIGIT\_SEP digit-separator-string [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **digit-separator-string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Digit separator symbol returned by LIB\$DIGIT\_SEP. The **digit-separator-string** argument is the address of a descriptor pointing to the digit separator.

##### **resultant-length**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of characters written into **digit-separator-string**, not counting padding in the case of a fixed-length string. The **resultant-length** argument is the address of an unsigned word containing the length of the digit separator symbol. If the input string is truncated to the size specified in the **digit-separator-string** descriptor, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **digit-separator-string**.

#### Description

LIB\$DIGIT\_SEP returns the symbol that is used to separate groups of three digits in the integer part of a number, for readability. A common digit separator is a comma (,) as in 3,006,854.

LIB\$DIGIT\_SEP attempts to translate the logical name SYS\$DIGIT\_SEP as a process, group, or system logical name. If the translation fails, LIB\$DIGIT\_SEP returns a comma (,), the United States digit separator. If the translation succeeds, the text produced is returned. Thus, a system manager can define SYS\$DIGIT\_SEP as a systemwide logical name to provide a default for all users, and an individual user with a special need can define SYS\$DIGIT\_SEP as a process logical name to override the default symbol. For example, you may want to use the European digit separator, the period (.).

BASIC implicitly uses LIB\$DIGIT\_SEP.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_STRTRU    | Successfully completed, but the digit separator string was truncated.   |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital. |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.  |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.   |

### Example

```
PROGRAM DIGIT_SEP(INPUT, OUTPUT);
{+}
{ This program uses LIB$DIGIT_SEP to return current
{ value of SYS$DIGIT_SEP.
{-}

routine LIB$DIGIT_SEP(%DESCR DIGIT SEPSTR : VARYING [A]
  OF CHAR; %REF OUT_LEN : INTEGER); EXTERN;

VAR
  SEPARATOR : VARYING [256] OF CHAR;
  LENGTH : INTEGER;

BEGIN
  LIB$DIGIT_SEP(SEPARATOR, LENGTH);
  WRITELN('104',SEPARATOR,'567',SEPARATOR,'934');
END.
```

This Pascal example demonstrates how to use LIB\$DIGIT\_SEP. The output generated by this program is as follows:

```
104,567,934
```

---

## LIB\$DISABLE\_CTRL

### Disable CLI Interception of Control Characters

The Disable CLI Interception of Control Characters routine requests the calling process's command language interpreter (CLI) to not intercept the selected control characters when they are entered during an interactive terminal session. LIB\$DISABLE\_CTRL provides the same function as the DCL command SET NOCONTROL.

#### Format

LIB\$DISABLE\_CTRL disable-mask [,old-mask]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### disable-mask

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Bit mask indicating which control characters are not to be intercepted. The **disable-mask** argument is the address of an unsigned longword containing this bit mask.

Each of the 32 bits corresponds to one of the 32 possible control characters. If a bit is set, the corresponding control character is no longer intercepted by the CLI. Currently, only bits 20 and 25, corresponding to Ctrl/T and Ctrl/Y, are recognized.

The following mask is defined in Digital-supplied symbol libraries to specify the value of **disable-mask**:

| Symbol           | Hex Value    | Function        |
|------------------|--------------|-----------------|
| LIB\$M_CLI_CTRLT | %X'00100000' | Disables Ctrl/T |
| LIB\$M_CLI_CTRLY | %X'02000000' | Disables Ctrl/Y |

If a set bit does not correspond to a character that the CLI can intercept, LIB\$DISABLE\_CTRL returns an error.

**old-mask**

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Previous bit mask. The **old-mask** argument is the address of an unsigned longword into which LIB\$DISABLE\_CTRL writes the old bit mask. The old bit mask is of the same form as **disable-mask** and indicates those control characters that were previously enabled. It may therefore be given to LIB\$ENABLE\_CTRL to reinstate the previous condition.

**Description**

The DCL and MCR CLIs can intercept the Ctrl/Y control character. The DCL CLI can intercept the Ctrl/T character. See the *OpenVMS DCL Dictionary* for information on how the DCL CLI processes control characters.

LIB\$DISABLE\_CTRL is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, LIB\$DISABLE\_CTRL returns the error status LIB\$\_NOCLI.

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_INVARG    | Invalid argument. A bit in <b>disable-mask</b> was set that did not correspond to a control character supported by the CLI.   |
| LIB\$_NOCLI     | No CLI present. Either the calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.   |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to Digital by means of a Software Performance Report (SPR). |

## LIB\$DO\_COMMAND

### Execute Command

The Execute Command routine stops program execution and directs the command language interpreter to execute a command that you supply as the argument. If successful, LIB\$DO\_COMMAND does not return control to the calling program. Instead, LIB\$DO\_COMMAND begins execution of the specified command.

If you want control to return to the caller, use LIB\$SPAWN instead.

### Format

LIB\$DO\_COMMAND command-string

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Argument

**command-string**  
OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Text of the command that LIB\$DO\_COMMAND executes. The **command-string** argument is the address of a descriptor pointing to the command text. The maximum length of the command is 255 characters.

### Description

LIB\$DO\_COMMAND terminates your current image and then executes the contents of **command-string** as a command. The command is parsed using normal DCL rules.

LIB\$DO\_COMMAND is especially useful when you want to execute a CLI command after your program has finished executing. For example, you could use the routine to execute a SUBMIT or PRINT command to handle a file that your program has created.

Because of the following restrictions on LIB\$DO\_COMMAND, you should be careful when you incorporate it in your program:

- During the call to LIB\$DO\_COMMAND, the current image exits and control cannot return to it.
- The text of the command is passed to the current command language interpreter. Because you can define your own CLI in addition to DCL and MCR, you must make sure that the command will be handled by the intended CLI.

- If LIB\$DO\_COMMAND is called from an image run directly as a subprocess or detached process, it will not execute correctly, because no CLI is associated with a subprocess.

LIB\$DO\_COMMAND is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, the error status LIB\$\_NOCLI is returned. Note that the command can execute an indirect file using the at sign (@) feature of DCL.

### Condition Values Returned

|                 |   |
|-----------------|---|
| LIB\$_INVARG    | Invalid argument. <b>command-string</b> was more than 255 characters.   |
| LIB\$_NOCLI     | No CLI present. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.  |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status that was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to Digital by means of a Software Performance Report (SPR). |

### Example

```
PROGRAM DO_COMMAND(INPUT, OUTPUT);
{+}
{ This example uses LIB$DO_COMMAND to execute
{ any DCL command that is entered by the user
{ at the prompt.
{-}
PROCEDURE LIB$DO_COMMAND(CMDTXT : VARYING [A] OF CHAR);
    EXTERN;
VAR
    COMMAND : VARYING [256] OF CHAR;
BEGIN
    WRITELN('ENTER THE COMMAND YOU WANT TO EXECUTE: ');
    READLN(COMMAND);
    LIB$DO_COMMAND(COMMAND);
END.
```

This Pascal program shows how to call LIB\$DO\_COMMAND. An example of the output of this program is as follows:

```
$ RUN DO COMMAND
ENTER THE COMMAND YOU WANT TO EXECUTE: SHOW TIME
30-MAY-1994 14:07:28
```

---

## LIB\$EDIV

### Extended-Precision Divide

The Extended-Precision Divide routine performs extended-precision division. LIB\$EDIV makes the VAX EDIV instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$EDIV longword-integer-divisor ,quadword-integer-dividend ,longword-integer-quotient ,remainder

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### longword-integer-divisor

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Divisor. The **longword-integer-divisor** argument is the address of a signed longword integer containing the divisor.

##### quadword-integer-dividend

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Dividend. The **quadword-integer-dividend** argument is the address of a signed quadword integer containing the dividend.

##### longword-integer-quotient

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Quotient. The **longword-integer-quotient** argument is the address of a signed longword integer containing the quotient.

##### remainder

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Remainder. The **remainder** argument is the address of a signed longword integer containing the remainder.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## Condition Values Returned

|             |   |
|-------------|---|
| SS\$_NORMAL | Normal successful operation.  |
| SS\$_INTOVF | Integer overflow. The quotient is replaced by bits 31:0 of the dividend, and the remainder is replaced by zero.       |
| SS\$_INTDIV | Integer divide by zero. The quotient is replaced by bits 31:0 of the dividend, and the remainder is replaced by zero. |

## Example

```

C+
C This Fortran program demonstrates how to use LIB$EDIV.
C-
      INTEGER DIVISOR,DIVIDEND(2),QUOTIENT,REMAINDER

C+
C Find the quotient and remainder of 4600387192 divided by 4096.
C Because 4600387192 is too large to store as a longword, use LIB$EDIV.
C-
      DIVISOR = 4096

C+
C The dividend must be represented as a quadword. To do this use a vector
C of length 2. The first element is the low-order longword, and the second
C element is the high-order longword.
C Now, 4600387192 = '00000000112345678'x. So,
C-
      DIVIDEND(1) = '12345678'X
      DIVIDEND(2) = '00000001'X

C+
C Compute the quotient and remainder of 4600387192 divided by 4096.
C-
      RETURN = LIB$EDIV(DIVISOR,DIVIDEND,QUOTIENT,REMAINDER)
      TYPE *, 'The longword integer quotient of 4600387192/4096 is:'
      TYPE *, '          ', QUOTIENT
      TYPE *, 'The longword integer remainder of 4600387192/4096 is:'
      TYPE *, '          ', REMAINDER
      END

```

This Fortran example demonstrates how to call LIB\$EDIV. The output generated by this program is as follows:

```

The longword integer quotient of 4600387192/4096 is:
      1123141
The longword integer remainder of 4600387192/4096 is:
      1656

```

---

## LIB\$EMODD

### Extended Multiply and Integerize Routines for D-Floating-Point Values

The Extended Multiply and Integerize routine (D-Floating-Point Values) allows higher level language users to perform accurate range reduction of D-floating arguments.

#### Alpha

D-floating-point values are not supported in full precision in native OpenVMS Alpha programs. They are precise to 56 bits on VAX systems, 53 or 56 bits in translated VAX images, and 53 bits in native OpenVMS Alpha programs. ♦

#### Format

LIB\$EMODD floating-point-multiplier ,multiplier-extension ,floating-point-multiplicand ,integer-portion  
,fractional-portion

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### floating-point-multiplier

OpenVMS usage: floating\_point  
type: D\_floating  
access: read only  
mechanism: by reference

The multiplier. The **floating-point-multiplier** argument is a D-floating number.

##### multiplier-extension

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

The left-justified multiplier-extension bits. The **multiplier-extension** argument is an unsigned byte.

##### floating-point-multiplicand

OpenVMS usage: floating\_point  
type: D\_floating  
access: read only  
mechanism: by reference

The multiplicand. The **floating-point-multiplicand** argument is a D-floating number.

**integer-portion**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: write only  
 mechanism: by reference

The integer portion of the result. The **integer-portion** argument is the address of a signed longword integer containing the integer portion of the result.

**fractional-portion**

OpenVMS usage: floating\_point  
 type: D\_floating  
 access: write only  
 mechanism: by reference

The fractional portion of the result. The **fractional-portion** argument is a D-floating number.

**Description**

The floating-point multiplier extension operand (second operand) is concatenated with the floating-point multiplier (first operand) to gain  $x$  additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted, and a  $y$ -bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of  $y$  bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of  $x$  and  $y$  are

| Routine    | $x$ | Bits | $y$ |
|------------|-----|------|-----|
| LIB\$EMODD | 8   | 7:0  | 64  |

**Condition Values Returned**

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| SS\$_INTOVF  | Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS\$_INTOVF also. |
| SS\$_FLTUND  | Floating underflow. The integer and fraction operands are replaced by zero (0).   |
| SS\$_ROPRAND | Reserved operand. The integer and fraction operands are unaffected.   |

## LIB\$EMODF

### Extended Multiply and Integerize Routines for F-Floating-Point Values

The Extended Multiply and Integerize routine (F-Floating-Point Values) allows higher-level-language users to perform accurate range reduction of F-floating arguments.

#### Format

LIB\$EMODF floating-point-multiplier ,multiplier-extension ,floating-point-multiplicand ,integer-portion  
,fractional-portion

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### floating-point-multiplier

OpenVMS usage: floating\_point  
type: F\_floating  
access: read only  
mechanism: by reference

The multiplier. The **floating-point-multiplier** argument is the address of an F-floating number containing the number.

##### multiplier-extension

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

The left-justified multiplier-extension bits. The **multiplier-extension** argument is the address of an unsigned byte containing these multiplier extension bits.

##### floating-point-multiplicand

OpenVMS usage: floating\_point  
type: F\_floating  
access: read only  
mechanism: by reference

The multiplicand. The **floating-point-multiplicand** argument is an F-floating number.

##### integer-portion

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: write only  
mechanism: by reference

The integer portion of the result. The **integer-portion** argument is the address of a signed longword integer containing the integer portion of the result.

**fractional-portion**

OpenVMS usage: floating\_point  
type: F\_floating  
access: write only  
mechanism: by reference

The fractional portion of the result. The **fractional-portion** argument is the address of an F-floating number containing the fractional portion of the result.

**Description**

LIB\$EMODF allows higher level language users to perform accurate range reduction of F-floating arguments.

The floating-point **multiplier-extension** operand (second operand) is concatenated with the **floating-point-multiplier** (first operand) to gain  $x$  additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a  $y$ -bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of  $y$  bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of  $x$  and  $y$  are as follows:

| Routine    | x | Bits | y  |
|------------|---|------|----|
| LIB\$EMODF | 8 | 7:0  | 32 |

**Condition Values Returned**

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| SS\$_INTOVF  | Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS\$_INTOVF also. |
| SS\$_FLTUND  | Floating underflow. The integer and fraction operands are replaced by zero.   |
| SS\$_ROPRAND | Reserved operand. The integer and fraction operands are unaffected.   |

---

## LIB\$EMODG

### Extended Multiply and Integerize Routines for G-Floating-Point Values

The Extended Multiply and Integerize routine (G-Floating-Point Values) allows higher-level-language users to perform accurate range reduction of G-floating arguments.

#### Format

LIB\$EMODG floating-point-multiplier ,multiplier-extension ,floating-point-multiplicand ,integer-portion  
,fractional-portion

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### floating-point-multiplier

OpenVMS usage: floating\_point  
type: G\_floating  
access: read only  
mechanism: by reference

The multiplier. The **floating-point-multiplier** argument is a G-floating number.

##### multiplier-extension

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

The left-justified multiplier-extension bits. The **multiplier-extension** argument is an unsigned word.

##### floating-point-multiplicand

OpenVMS usage: floating\_point  
type: G\_floating  
access: read only  
mechanism: by reference

The multiplicand. The **floating-point-multiplicand** argument is a G-floating number.

##### integer-portion

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

The integer portion of the result. The **integer-portion** argument is the address of a signed longword integer containing the integer portion of the result.

**fractional-portion**

OpenVMS usage: floating\_point  
 type: G\_floating  
 access: write only  
 mechanism: by reference

The fractional portion of the result. The **fractional-portion** argument is a G-floating number.

**Description**

The floating-point multiplier extension operand (second operand) is concatenated with the floating-point multiplier (first operand) to gain  $x$  additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a  $y$ -bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of  $y$  bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of  $x$  and  $y$  are as follows:

| Routine    | x  | Bits | y  |
|------------|----|------|----|
| LIB\$EMODG | 11 | 15:5 | 64 |

**Condition Values Returned**

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| SS\$_INTOVF  | Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS\$_INTOVF also. |
| SS\$_FLTUND  | Floating underflow. The integer and fraction operands are replaced by zero.   |
| SS\$_ROPRAND | Reserved operand. The integer and fraction operands are unaffected.   |

---

## LIB\$EMODH

### Extended Multiply and Integerize Routines for H-Floating-Point Values

On OpenVMS VAX systems, the Extended Multiply and Integerize routine (H-Floating-Point Values) allows higher-level-language users to perform accurate range reduction of H-floating arguments.

#### Alpha

This routine is not available to native OpenVMS Alpha programs but is available to translated VAX images. ♦

#### Format

LIB\$EMODH floating-point-multiplier ,multiplier-extension ,floating-point-multiplicand ,integer-portion  
,fractional-portion

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### floating-point-multiplier

OpenVMS usage: floating\_point  
type: H\_floating  
access: read only  
mechanism: by reference

The multiplier. The **floating-point-multiplier** argument is an H-floating number.

##### multiplier-extension

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

The left-justified multiplier-extension bits. The **multiplier-extension** argument is an unsigned word.

##### floating-point-multiplicand

OpenVMS usage: floating\_point  
type: H\_floating  
access: read only  
mechanism: by reference

The multiplicand. The **floating-point-multiplicand** argument is an H-floating number.

**integer-portion**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: write only  
 mechanism: by reference

The integer portion of the result. The **integer-portion** argument is the address of a signed longword integer containing the integer portion of the result.

**fractional-portion**

OpenVMS usage: floating\_point  
 type: H\_floating  
 access: write only  
 mechanism: by reference

The fractional portion of the result. The **fractional-portion** argument is an H-floating number.

**Description**

The floating-point multiplier extension operand (second operand) is concatenated with the floating-point multiplier (first operand) to gain  $x$  additional low-order fraction bits. The multiplicand is multiplied by the extended multiplier. After multiplication, the integer portion is extracted and a  $y$ -bit floating-point number is formed from the fractional part of the product by truncating extra bits.

The multiplication yields a result equivalent to the exact product truncated to a fraction field of  $y$  bits. With respect to the result as the sum of an integer and fraction of the same sign, the integer operand is replaced by the integer part of the result and the fraction operand is replaced by the rounded fractional part of the result.

The values of  $x$  and  $y$  are as follows:

| Routine    | $x$ | Bits | $y$ |
|------------|-----|------|-----|
| LIB\$EMODH | 15  | 15:1 | 128 |

**Condition Values Returned**

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| SS\$_INTOVF  | Integer overflow. The integer operand is replaced by the low-order bits of the true result. Floating overflow is indicated by SS\$_INTOVF also. |
| SS\$_FLTUND  | Floating underflow. The integer and fraction operands are replaced by zero.   |
| SS\$_ROPRAND | Reserved operand. The integer and fraction operands are unaffected.   |

## LIB\$EMUL

### Extended-Precision Multiply

The Extended-Precision Multiply routine performs extended-precision multiplication. LIB\$EMUL makes the VAX EMUL instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$EMUL longword-integer-multiplier ,longword-integer-multiplicand ,addend ,product

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **longword-integer-multiplier**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Multiplier used by LIB\$EMUL in the extended-precision multiplication. The **longword-integer-multiplier** argument is the address of a signed longword integer containing the multiplier.

##### **longword-integer-multiplicand**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Multiplicand used by LIB\$EMUL in the extended-precision multiplication. The **longword-integer-multiplicand** argument is the address of a signed longword integer containing the multiplicand.

##### **addend**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Addend used by LIB\$EMUL in the extended-precision multiplication. The **addend** argument is the address of a signed longword integer containing the addend.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

**product**

OpenVMS usage: quadword\_signed  
 type: quadword integer (signed)  
 access: write only  
 mechanism: by reference

Product of the extended-precision multiplication. The **product** argument is the address of a signed quadword integer into which LIB\$EMUL writes the product.

**Description**

The multiplicand argument is multiplied by the multiplier argument giving a double-length result. The addend argument is sign-extended to double-length and added to the result. LIB\$EMUL then writes the result into the **product** argument.

**Condition Values Returned**

SS\$\_NORMAL                      Routine successfully completed.

**Example**

```

      INTEGER MULT1,MULT2,ADDEND,PRODUCT(2)
C+
C Find the extended precision multiplication of 268435456 times 4096.
C That is, find the extended precision product of 2**28 times 2**12.
C Since 268435456 times 4096 is 2**40, a quadword value is needed for
C the calculation: use LIB$EMUL.
C-
      MULT1 = 4096
      MULT2 = 268435456
      APPEND = 0
C+
C Compute 268435456*4096.
C Note that product will be stored as a quadword. This value will be stored
C in the 2 dimensional vector PRODUCT. The first element of PRODUCT will
C contain the low order bits, while the second element will contain the high
C order bits.
C-
      RETURN = LIB$EMUL(MULT1,MULT2,APPEND,PRODUCT)
      TYPE *, 'PRODUCT(2) =',PRODUCT(2),' and PRODUCT(1) = ',PRODUCT(1)
      TYPE *, ' '
      TYPE *, 'Note that 256 and 0 represent the hexadecimal value'
      type *, '14H'1000000000'x,', which in turn, represents 2**40.'
      END

```

This Fortran program demonstrates how to use LIB\$EMUL. The output generated by this program is as follows:

```

      PRODUCT(2) =          256 and PRODUCT(1) =          0

```

Note that 256 and 0 represent the hexadecimal value '1000000000'x, which in turn represents 2<sup>40</sup>.

---

## LIB\$ENABLE\_CTRL

### Enable CLI Interception of Control Characters

The Enable CLI Interception of Control Characters routine requests the calling process's command language interpreter (CLI) to resume interception of the selected control characters when they are typed during an interactive terminal session. LIB\$ENABLE\_CTRL provides the same function as the DCL command SET CONTROL.

#### Format

LIB\$ENABLE\_CTRL enable-mask [,old-mask]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### enable-mask

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Bit mask indicating for which control characters LIB\$ENABLE\_CTRL is to enable interception. The **enable-mask** argument is the address of an unsigned longword containing this bit mask. Each of the 32 bits corresponds to one of the 32 possible control characters. If a bit is set, the corresponding control character is intercepted by the CLI. Currently, only bits 20 and 25, corresponding to Ctrl/T and Ctrl/Y, are recognized.

The following mask is defined in Digital-supplied symbol libraries to specify the value of **enable-mask**:

| Symbol           | Hex Value    | Function       |
|------------------|--------------|----------------|
| LIB\$M_CLI_CTRLT | %X'00100000' | Enables Ctrl/T |
| LIB\$M_CLI_CTRLY | %X'02000000' | Enables Ctrl/Y |

If a set bit does not correspond to a character which the CLI can intercept, an error is returned.

##### old-mask

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Previous bit mask. The **old-mask** argument is the address of an unsigned longword containing the old bit mask. The old bit mask is of the same form as **enable-mask**.

## Description

LIB\$ENABLE\_CTRL provides the functions of the DCL SET CONTROL command. Normally, Ctrl/Y interrupts the current command, command procedure, or image. After a call to LIB\$DISABLE\_CTRL, Ctrl/Y is treated like Ctrl/U followed by a carriage return. LIB\$ENABLE\_CTRL restores the normal operation of Ctrl/Y or Ctrl/T.

Both the DCL and MCR CLIs can intercept control characters. See the *OpenVMS DCL Dictionary* for information on how the CLI processes control characters.

LIB\$ENABLE\_CTRL is supported for use with the DCL or MCR CLIs.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, the error status LIB\$\_NOCLI is returned.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_INVARG    | Invalid argument. A bit in <b>enable-mask</b> was set which did not correspond to a control character supported by the CLI.  |
| LIB\$_NOCLI     | No CLI present. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.   |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to Digital by means of a Software Performance Report (SPR). |

## LIB\$ESTABLISH

### Establish a Condition Handler

The Establish a Condition Handler routine moves the address of a condition handling routine (which can be a user-written or a library routine) to longword 0 of the stack frame of the caller of LIB\$ESTABLISH.†

#### Alpha

This routine is not available to native OpenVMS Alpha programs but is recognized and handled appropriately by most Digital high-level language compilers. ♦

#### Format

LIB\$ESTABLISH new-handler

#### Returns

OpenVMS usage: routine  
type: procedure value  
access: write only  
mechanism: by reference

Previous contents of SF\$A\_HANDLER (longword 0) of the caller's stack frame; zero if no handler existed.

#### Argument

##### new-handler

OpenVMS usage: procedure  
type: procedure value  
access: read only  
mechanism: by value

Routine to be set up as the condition handler. The **new-handler** argument is the address of the procedure value to this routine.

#### Description

LIB\$ESTABLISH moves the address of a condition-handling routine to longword 0 of the stack frame of the caller of LIB\$ESTABLISH. This condition-handling routine then becomes the caller's condition handler. LIB\$ESTABLISH returns the previous contents of longword 0. This can either be the address of the caller's previous condition handler or zero if no handler existed.

The new condition handler remains in effect for your routine until you call LIB\$REVERT or until control returns to the caller of the routine that called LIB\$ESTABLISH. Once this happens, you must call LIB\$ESTABLISH again if the same (or a new) condition handler is to be associated with the routine that called LIB\$ESTABLISH.

LIB\$ESTABLISH modifies the caller's stack frame.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

LIB\$ESTABLISH is provided primarily for use with languages without built-in error handling facilities. Do not use LIB\$ESTABLISH with languages that provide error handling, such as BASIC, COBOL, Pascal, and PL/I. Use of this routine with these languages may adversely affect the behavior of your program. The language-support library for these languages depends on predefined language-specific handlers. Also, the handler address is used to identify the stack frames of routines written in these languages. See the documentation for the language you are using for more information about how that language handles errors.

In VAX MACRO, you merely use the following instruction instead of calling LIB\$ESTABLISH:

```
MOVAB HANDLER, (FP)      ; set handler address
                        ; in current stack frame
```

### Condition Values Returned

None.

### Example

```
C+
C This Fortran program demonstrates the
C use of LIB$ESTABLISH.
C
C This is the main program.
C-

      EXTERNAL LOG_HANDL
      CHARACTER TIMBUF
      OPEN (UNIT=99, FILE = 'ERRLOG', STATUS = 'NEW')
      CALL LIB$ESTABLISH (LOG_HANDL)

      CALL SYS$BINTIM (TIMBUF, TIMADR)

C+
C The rest of the main program would go here.
C-

      END

      INTEGER*4 FUNCTION LOG_HANDL (SIGARGS, MECHARGS)
      INTEGER*4 SIGARGS (*), MECHARGS (5)

C+
C This is the handler to journal any signaled error messages.
C-

      INCLUDE '($SSDEF)'
      EXTERNAL PUT_LINE
      LOG_HANDL = $$ RESIGNAL
      CALL SYS$PUTMSG (SIGARGS, PUT_LINE, )
      RETURN
      END

C+
C This is the action subroutine.
C-

      LOGICAL*4 FUNCTION PUT_LINE (LINE)
      CHARACTER*(*)LINE
      PUT_LINE = .FALSE.
100  WRITE (99,200)LINE
200  FORMAT (A)
      RETURN
      END
```

## LIB\$ Routines LIB\$ESTABLISH

In this Fortran example, the function **log\_handl** is the condition handler for the program, and thus receives control when an error occurs.

---

## LIB\$EXPAND\_NODENAME

### Expand a Node Name to Its Full Name Equivalent

The Expand a Node Name to Its Full Name Equivalent routine expands a node name to its full name equivalent.†

#### Format

LIB\$EXPAND\_NODENAME nodename, fullname [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

##### **nodename**

OpenVMS usage: char\_string  
 type: character string  
 access: read only  
 mechanism: by descriptor

Node name to be expanded. The **nodename** argument contains the address of a descriptor pointing to this node-name string.

The error LIB\$\_INVARG is returned if **nodename** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if **nodename** is an invalid descriptor.

##### **fullname**

OpenVMS usage: char\_string  
 type: character string  
 access: write only  
 mechanism: by descriptor

Expanded node name. The **fullname** argument contains the address of a descriptor pointing to the expanded node-name string. LIB\$EXPAND\_NODENAME writes the expanded node-name string into the buffer pointed to by the **fullname** descriptor.

The error LIB\$\_INVSTRDES is returned if **fullname** is an invalid descriptor.

The length field of the **fullname** descriptor is not updated unless **fullname** is a dynamic descriptor with a length less than the resulting expanded full name. Refer to the *OpenVMS RTL String Manipulation (STR\$) Manual* for dynamic string descriptor usage.

The **fullname** argument contains an unusable result when LIB\$EXPAND\_NODENAME returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$EXPAND\_NODENAME

#### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the expanded node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB\$EXPAND\_NODENAME returns in error.

## Description

This routine expands the input node name to its full name equivalent. Input is validated against the supported form of node names. The error LIB\$\_INVARG is returned if the input node name is invalid.

If the returned full name overflows the buffer pointed to by **fullname**, the returned full name is truncated, and the alternate successful status LIB\$\_STRTRU is returned. The **resultant-length** argument is set to the value of the length field of the **fullname** descriptor if this argument is supplied.

If the length of the returned full name is less than or equal to the output buffer, the expanded full name is returned in **fullname**. **Resultant-length** is set to the actual length of the expanded full name if this argument is supplied.

On a DECnet Phase IV system, expanding a DECnet/OSI node name results in the error condition LIB\$\_INVARG.

LIB\$EXPAND\_NODENAME uses the underlying network directory services to look up the full name. In a DECnet/OSI environment, LIB\$EXPAND\_NODENAME verifies the existence of the expanded full name in the naming environment. If the expanded full name does not exist in the naming environment, an error condition is returned from the underlying network services and is propagated back to the caller of LIB\$EXPAND\_NODENAME.

It is recommended that applications use full names instead of the short form of full names whenever possible. Because the short form of a full name is intended to be used only in a specific naming environment, make sure the short form of a full name is expanded in the right naming environment to avoid ambiguity. See LIB\$COMPRESS\_NODENAME for more information about where and when to use the short form of a full name.

Any error resulting from calling the underlying network services is propagated and returned as condition values in this routine.

LIB\$EXPAND\_NODENAME supports any string class for the **nodename** and **fullname** string arguments.

## Condition Values Returned

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| LIB\$_STRTRU | Routine successfully completed. Characters are truncated in the output buffer pointed to by the <b>fullname</b> descriptor. |

**LIB\$ Routines**  
**LIB\$EXPAND\_NODENAME**

LIB\$\_INVARG

Invalid argument:

- **nodename** is invalid.
- **nodename** points to a null string.
- The length of the node name is more than 1024 characters.
- The expanded DECnet/OSI node name is invalid in a DECnet Phase IV system.

LIB\$\_INVSTRDES

Invalid string descriptor.

LIB\$\_WRONUMARG

Wrong number of arguments.

Any condition value returned by LIB\$SCOPY\_R\_DX.

Any condition value returned by the \$IPC DECnet service.

## LIB\$EXTV

### Extract a Field and Sign-Extend

The Extract a Field and Sign-Extend routine returns a sign-extended longword field that has been extracted from the specified variable bit field. LIB\$EXTV makes the VAX EXTV instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$EXTV position ,size ,base-address

#### Returns

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by value

Field extracted by LIB\$EXTV, sign-extended to a longword.

#### Arguments

##### position

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Position (relative to the base address) of the first bit in the field that LIB\$EXTV extracts. The **position** argument is the address of a signed longword integer containing the position.

##### size

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Size of the bit field LIB\$EXTV extracts. The **size** argument is the address of an unsigned byte containing the size. The maximum size is 32 bits.

##### base-address

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by value

Base address of the bit field LIB\$EXTV extracts from the specified variable bit field. The **base-address** argument is an unsigned longword containing the base address.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

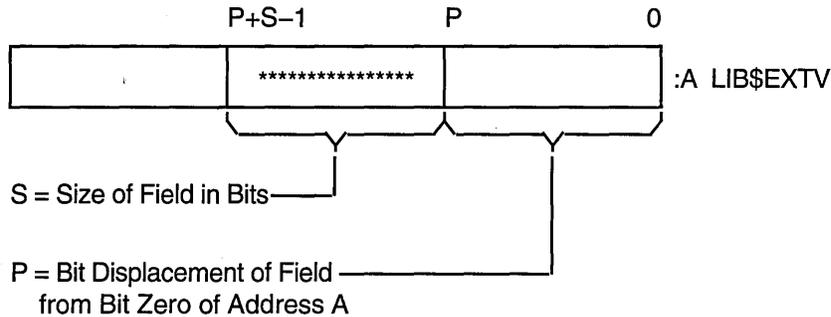
## Description

The variable-length bit field is an OpenVMS data type used to store small integers packed together in a larger data structure. It is often used to store single flag bits.

Three scalar attributes define a variable bit field:

- The base address is the address of a byte in memory that serves as a reference point for locating the bit field.
- The bit position is a signed longword containing the displacement of the least significant bit of the field with respect to bit 0 of the base address.
- The size is a byte integer indicating the size of the bit field in bits (in the range  $0 \leq \text{size} \leq 32$ ). That is, a bit field can be no more than one longword in length.

A variable-length bit field has the following format. The area containing asterisks indicates the field.



ZK-1940-GE

Bit fields are zero-origin, which means that the routine regards the first bit in the field as being the zero position.

## Condition Value Signaled

SS\$\_ROPRAND                      A reserved operand fault occurs if a size greater than 32 is specified.

## Example

```
SIGN_EXTEND: ROUTINE OPTIONS (MAIN);
DECLARE LIB$EXTV ENTRY
    (FIXED BINARY (31),      /* Address of longword containing
                           /* beginning bit position      */
    FIXED BINARY (7),      /* Address of byte containing size
                           /* of field                    */
    FIXED BINARY (31))     /* Address of field            */
    RETURNS (FIXED BINARY (31)); /* Return value              */
DECLARE (VALUE, SMALL_INT) FIXED BINARY (31);
ON ENDFILE (SYSIN) STOP;
```

## LIB\$ Routines

### LIB\$EXTV

```
DO WHILE ('1'B);          /* Loop continuously, until end of file */
  PUT SKIP(2);
  GET LIST (VALUE) OPTIONS (PROMPT ('Value: '));
  SMALL_INT = LIB$EXTV ( 0, 4, VALUE); /* Extract and sign-extend
                                        /* first 4 bits      */
  PUT SKIP LIST (VALUE, SMALL_INT);
  END;
END SIGN_EXTEND;
```

This PL/I program extracts a field and returns it sign-extended into a longword.

---

## LIB\$EXTZV

### Extract a Zero-Extended Field

The Extract a Zero-Extended Field routine returns a longword zero-extended field that has been extracted from the specified variable bit field. LIB\$EXTZV makes the VAX EXTZV instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$EXTZV position ,size ,base-address

#### Returns

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by value

Field extracted by LIB\$EXTZV, zero-extended to a longword.

#### Arguments

##### position

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Position (relative to the base address) of the first bit in the field LIB\$EXTZV extracts. The **position** argument is the address of a signed longword integer containing the position.

##### size

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Size of the bit field LIB\$EXTZV extracts. The **size** argument is the address of an unsigned byte containing the size. The maximum size is 32 bits.

##### base-address

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by value

Base address of the bit field LIB\$EXTZV extracts. The **base-address** argument is an unsigned longword containing the base address.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

# LIB\$ Routines

## LIB\$EXTZV

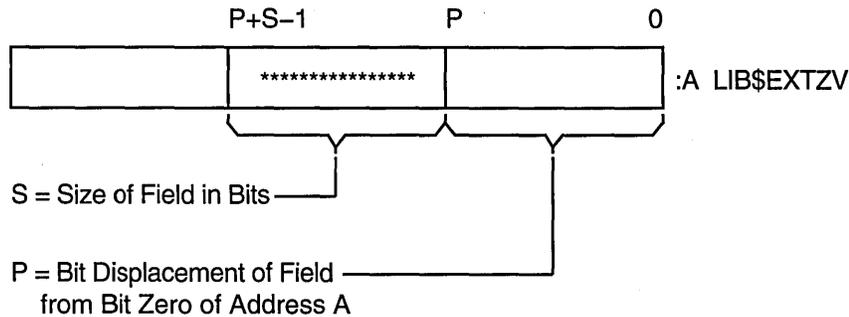
### Description

The variable-length bit field is an OpenVMS data type used to store small integers packed together in a larger data structure. It is often used to store single flag bits.

Three scalar attributes define a variable bit field:

- The base address is the address of the byte in memory that serves as a reference point for locating the bit field.
- The bit position is a signed longword containing the displacement of the least significant bit of the field with respect to bit 0 of the base address.
- The size is a byte integer indicating the size of the bit field in bits (in the range  $0 \leq \text{size} \leq 32$ ). That is, a bit field can be no more than one longword in length.

A variable-length bit field has the following format. The area containing asterisks indicates the field.



ZK-1941-GE

Bit fields are zero-origin fields, which means that the routine regards the first bit in the field as being the zero position.

### Condition Value Signaled

SS\$\_ROPRAND

A reserved operand fault occurs if a size greater than 32 is specified.

---

## LIB\$FFx

### Find First Clear or Set Bit

The Find First Clear or Set Bit routines search the field specified by the start position, size, and base for the first clear or set bit. LIB\$FFC and LIB\$FFS make the VAX FFC and VAX FFS instructions available as callable routines.<sup>1</sup>

#### Format

LIB\$FFC position ,size ,base ,find-position

LIB\$FFS position ,size ,base ,find-position

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### position

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Starting position, relative to the base address, of the bit field to be searched by LIB\$FFx. The **position** argument is the address of a signed longword integer containing the starting position.

##### size

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Number of bits to be searched by LIB\$FFx. The **size** argument is the address of an unsigned byte containing the size of the bit field to be searched. The maximum size is 32 bits.

##### base

OpenVMS usage: address  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The **base** argument is the address of the bit field which LIB\$FFx searches.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$ Routines

### LIB\$FFx

#### **find-position**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Bit position of the first bit in the specified state (clear or set), relative to the base address. The **find-position** argument is the address of a signed longword integer into which LIB\$FFC writes the position of the first clear bit and into which LIB\$FFS writes the position of the first set bit.

#### **Description**

LIB\$FFC searches the field specified by the start position, size, and base for the first clear bit. LIB\$FFS searches the field for the first set bit.

If a bit in the specified state is found, LIB\$FFx writes the position (relative to the base) of that bit into **find-position** and returns a success status. If no bits are in the specified state or if **size** is zero, LIB\$FFx returns LIB\$\_NOTFOU and sets **find-position** to the starting position plus the size.

LIB\$FFx regards the first bit in the field as being the zero position.

#### **Condition Values Returned**

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed. A bit in the specified state was found. |
| LIB\$_NOTFOU | A bit in the specified state was not found.                             |

#### **Condition Value Signaled**

|              |   |
|--------------|---|
| SS\$_ROPRAND | Reserved operand fault. A size greater than 32 was specified. |
|--------------|---|

---

## LIB\$FID\_TO\_NAME

### Convert Device and File ID to File Specification

The Convert Device and File ID to File Specification routine converts a disk device name and file identifier to a file specification.

#### Format

LIB\$FID\_TO\_NAME device-name ,file-id ,filespec [,filespec-length] [,directory-id] [,acp-status]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### device-name

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Device name to be converted. The **device-name** argument is the address of a descriptor pointing to the device name. It must reference a disk device, and must contain 64 characters or less. LIB\$FID\_TO\_NAME obtains **device-name** from the NAM\$T\_DVI field of a RMS name block.

##### file-id

OpenVMS usage: vector\_word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference, array reference

Specifies the file identifier. The **file-id** argument is the address of an array of three words containing the file identification. LIB\$FID\_TO\_NAME obtains **file-id** from the NAM\$W\_FID field of a RMS name block. The \$FIDDEF macro defines the structure of **file-id**.

##### filespec

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Receives the file specification. The **filespec** argument is the address of a descriptor pointing to the file specification string. Refer to the Description section for more information about the file specification returned.

##### filespec-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

## LIB\$ Routines

### LIB\$FID\_TO\_NAME

Receives the number of characters written into **filespec**, excluding padding in the case of a fixed-length string. The optional **filespec-length** argument is the address of an unsigned word containing the number of characters.

If the output string is truncated to the number of characters specified in **filespec**, then **filespec-length** is set to that truncated size. Therefore, you can always use **filespec-length** to access a valid substring of **filespec**.

#### directory-id

OpenVMS usage: vector\_word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference, array reference

Specifies a directory file identifier. The **directory-id** argument is the address of an array of three words containing the directory file identifier. LIB\$FID\_TO\_NAME obtains this array from the NAM\$W\_DID field of a RMS name block. The \$FIDDEF macro defines the structure of **directory-id**.

#### acp-status

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by reference

The status resulting from traversing the backward links. The optional **acp-status** argument is the address of an unsigned longword containing the status.

## Description

LIB\$FID\_TO\_NAME converts a disk device name and file identifier to a file specification by requesting the ACP file specification attribute.



On OpenVMS VAX systems, if you use the LIB\$FID\_TO\_NAME routine on a structure level 1 disk, specify the **directory-id** argument to ensure proper operation of the routine. ♦

LIB\$FID\_TO\_NAME uses the directory backpointer stored in the file header. With files in SYS\$COMMON, the directory structure is duplicated because of some SET FILE/ENTERS of directory names. If directory names have been renamed or the tree structure modified (which the OpenVMS operating system does with the [SYCOMMON] tree), the file specification returned by this routine may not be useful.

LIB\$FID\_TO\_NAME stores the output arguments (**filespec**, **filespec-length**, and **acp-status**) only if the routine successfully finishes.

### Condition Values Returned

|                |  |
|----------------|--|
| LIB\$NORMAL    | Routine successfully completed.  |
| LIB\$STRTRU    | Output string truncated (qualified success).                                   |
| LIB\$INVARG    | Required argument omitted, or <b>device-name</b> is longer than 64 characters. |
| LIB\$INVFILSPE | The <b>device-name</b> argument does not reference a disk.                     |

Any condition value returned by LIB\$ANALYZE\_SDESC, SYS\$ASSIGN, SYS\$QIO, or SYS\$DASSGN.

---

## LIB\$FILE\_SCAN

### File Scan

The File Scan routine searches an area, such as a directory, for all files matching the file specification given and transfers program execution to the specified user-written routine. Wildcards are acceptable. An action routine is called for each file and/or error found. LIB\$FILE\_SCAN allows the search sequence to continue even if an error occurs while processing a particular file.

#### Format

LIB\$FILE\_SCAN fab ,user-success-procedure ,user-error-procedure [,context]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### fab

OpenVMS usage: fab  
type: unspecified  
access: read only  
mechanism: by reference

File Access Block (FAB) referencing a valid NAM block. The **fab** argument is the address of the FAB which contains the address and length of the file specification being searched for by LIB\$FILE\_SCAN.

##### user-success-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied success routine that LIB\$FILE\_SCAN calls when a file is found. The success routine is invoked with the FAB address that was passed to LIB\$FILE\_SCAN. The user context may be passed to this routine using the FAB\$L\_CTX field in the FAB.

##### user-error-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied error routine that LIB\$FILE\_SCAN calls when it encounters an error. The error routine is called with the FAB argument that was passed to LIB\$FILE\_SCAN.

**context**

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Default file context used in processing file specifications for multiple input files. The **context** argument is the address of a longword, which must be initialized to zero by your program before the first call to LIB\$FILE\_SCAN. After the first call, LIB\$FILE\_SCAN maintains this longword. You must not change the value of **context** in subsequent calls to LIB\$FILE\_SCAN.

Name blocks and file specification strings are allocated by LIB\$FILE\_SCAN, and **context** is used to retain their addresses so they may be deallocated later. If the **context** argument is not passed, unspecified portions of the file specification will be inherited from the previous file specification processed, rather than from multiple input file specifications.

**Description**

LIB\$FILE\_SCAN is called with the address of a File Access Block (FAB) and calls an action routine for each file found and/or error returned. LIB\$FILE\_SCAN allows the search sequence to continue even if an error occurs while processing a particular file.

If this routine is called once for each file specification argument in a command line, portions of the file specifications which are not specified by the user are inherited from the last files processed.

You must call LIB\$FILE\_SCAN\_END before initiating a new sequence of calls to LIB\$FILE\_SCAN.

**Condition Values Returned**

Any condition value returned by the Record Management Service (RMS) Parse.

---

## LIB\$FILE\_SCAN\_END

### End-of-File Scan

The End-of-File Scan routine is called after each sequence of calls to LIB\$FILE\_SCAN. LIB\$FILE\_SCAN\_END deallocates any saved Record Management Service (RMS) context and/or deallocates the virtual memory that had been allocated for holding the related file specification information.

#### Format

LIB\$FILE\_SCAN\_END [fab] [,context]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### fab

OpenVMS usage: fab  
type: unspecified  
access: modify  
mechanism: by reference

File access block (FAB) used with LIB\$FILE\_SCAN. The optional **fab** argument is the address of the FAB that contains the address and length of the file specification.

##### context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Temporary default context used in LIB\$FILE\_SCAN. The optional **context** argument is the address of a longword containing this temporary default context.

#### Description

Your program should call LIB\$FILE\_SCAN\_END after each sequence of calls to LIB\$FILE\_SCAN. The function that LIB\$FILE\_SCAN\_END performs depends upon the arguments you specify. If you specify **fab**, LIB\$FILE\_SCAN\_END parses the null string to deallocate any saved RMS context. If you specify **context**, LIB\$FILE\_SCAN\_END deallocates any virtual memory that was allocated for holding the related file specification information. If you specify both **fab** and **context**, LIB\$FILE\_SCAN\_END performs both functions. However, if you do not specify either argument, LIB\$FILE\_SCAN\_END does nothing.

If LIB\$FILE\_SCAN is directed to process the specifications for multiple input files, LIB\$FILE\_SCAN\_END is used to deallocate those saved file specifications. If LIB\$FILE\_SCAN\_END is called by your program after each sequence of calls to LIB\$FILE\_SCAN, it will prevent the defaults from the previous call from affecting context value in the next call to LIB\$FILE\_SCAN. LIB\$FILE\_SCAN\_END does this by replacing the context value passed to it with a temporary context value that your program passes to LIB\$FILE\_SCAN the next time it is called.

### **Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

RMS\$\_FAB

The **fab** argument is not the address of a valid FAB.

---

## LIB\$FIND\_FILE

### Find File

The Find File routine is called with a file specification for which it searches. LIB\$FIND\_FILE returns one file specification for each call. The file specification may contain wildcards.

#### Format

```
LIB$FIND_FILE filespec ,resultant-filespec ,context [,default-filespec] [,related-filespec] [,status-value]
              [,flags]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File specification, which may contain wildcards, that LIB\$FIND\_FILE uses to search for the desired file. The **filespec** argument is the address of a descriptor pointing to the file specification. The maximum length of a file specification is 255 bytes.

The file specification used may also contain a search list logical name. If present, the search list logical name elements can be used as accumulative to related file specifications, so that portions of file specifications not specified by the user are inherited from previous file specifications.

##### resultant-filespec

OpenVMS usage: char\_string  
type: character string  
access: modify  
mechanism: by descriptor

Resultant file specification that LIB\$FIND\_FILE returns when it finds a file that matches the specification in the **filespec** argument. The **resultant-filespec** argument is the address of a descriptor pointing to the resultant file specification.

##### context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

A longword integer variable into which the routine stores a context value for use by future calls to LIB\$FIND\_FILE or LIB\$FIND\_FILE\_END. The **context** argument is an unsigned longword integer containing the address of the context.

This variable must be set to zero before the first call to LIB\$FIND\_FILE. You can use the same **context** argument from one LIB\$FIND\_FILE call to another provided you have not called LIB\$FIND\_FILE\_END for that **context** first. LIB\$FIND\_FILE uses this argument to retain the context when processing multiple input files. Portions of file specifications that the user does not specify may be inherited from the last files processed because the file contexts are retained in this argument.

#### default-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Default file specification. The **default-filespec** argument is the address of a descriptor pointing to the default file specification. See the *OpenVMS Record Management Services Reference Manual* for information about default file specifications.

#### related-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Related file specification containing the context of the last file processed. The **related-filespec** argument is the address of a descriptor pointing to the related file specification.

The related file specification is useful when you are processing lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed. For more information on related file specifications, see the *OpenVMS Record Management Services Reference Manual*.

#### status-value

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Record Management Service (RMS) secondary status value from a failing RMS operation. The **status-value** argument is an unsigned longword containing the address of a longword-length buffer to receive the RMS secondary status value (usually returned in the file access block field, FAB\$L\_STV).

#### flags

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

User flags. The **flags** argument is the address of an unsigned longword containing the user flags.

## LIB\$ Routines

### LIB\$FIND\_FILE

The flag bits and their corresponding symbols are described in the following table:

| Bit | Symbol   | Description  |
|-----|----------|--|
| 0   | NOWILD   | If set, LIB\$FIND_FILE returns an error if a wildcard character is input.  |
| 1   | MULTIPLE | If set, this performs temporary defaulting for multiple input files and the <b>related-filespec</b> argument is ignored. See description of <b>context</b> in LIB\$FILE_SCAN. Each time LIB\$FIND_FILE is called with a different file specification, the specification from the previous call is automatically used as a related file specification. This allows parsing of the elements of a search-list logical name such as DISK2:[SMITH] FIL1.TYP,FIL*2.TYP, and so on. Use of this feature is required to get the desired defaulting with search list logical name. LIB\$FIND_FILE_END must be called between each command line in interactive use or the defaults from the previous command line affect the current file specification. |

## Description

LIB\$FIND\_FILE returns one file specification per call unless it fails to find the target file specification. In this case, the routine returns the condition value RMS\$\_NMF (no more files). Each successful call to LIB\$FIND\_FILE results in a new **resultant-filespec**.

When you call LIB\$FIND\_FILE repeatedly using the same **context**, **filespec** is saved only if you set the MULTIPLE bit. If you specify a different **filespec** on your next call and set the MULTIPLE bit, the file specification from the previous call defaults as the related file specification.

For each LIB\$FIND\_FILE call, RMS first applies the defaults from **default-filespec** and then uses the defaults from **related-filespec**, if relevant. Default file specifications are used only if components are missing from the **filespec** argument and the needed components are found in **default-filespec**. The **related-filespec** argument is used when you process lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed. This provides an extra level of file specification defaults. For additional information on related file specifications and input file parsing, see the *Guide to OpenVMS File Applications*.

The **filespec** argument can contain wildcard characters. LIB\$FIND\_FILE can be called repeatedly using the same **context** argument until the error RMS\$\_NMF (no more files) is returned.

LIB\$FIND\_FILE searches for a certain wildcard file specification and returns all file specifications that satisfy that wildcard file specification.

If you make multiple calls to LIB\$FIND\_FILE, be aware of the following behavior:

- If the NOWILD bit is not set and the file specification does not contain any wildcard characters, LIB\$FIND\_FILE returns the appropriate file name on the first call and the condition value RMS\$\_NMF on the next call.
- If the NOWILD bit is set and you use the same nonwildcard file specification, LIB\$FIND\_FILE returns the file name on the first call as well as each subsequent call.

You must call LIB\$FIND\_FILE\_END before initiating a new sequence of calls to LIB\$FIND\_FILE to properly deallocate all of the internal data structures that were allocated in the calls to LIB\$FIND\_FILE. After you call LIB\$FIND\_FILE\_END, the context value is no longer valid and cannot be used on any subsequent LIB\$FIND\_FILE calls.

If the error RMS\$\_CHN is returned, RMS has no more channels to assign. There are two possible reasons for this:

- You did not call LIB\$FIND\_FILE\_END before initiating a new call with a context variable to LIB\$FIND\_FILE. (This is the most common reason.)
- The system parameter CHANNELCNT is too low.

### Condition Values Returned

|              |  |
|--------------|--|
| RMS\$_NORMAL | Routine successfully completed.  |
| LIB\$_NOWILD | A wildcard character was present in the file specification parsed, and the wildcard flag bit was set to no wildcard. (This is actually the SHR\$_NOWILD error message after application of the LIB\$ facility code.) |
| RMS\$_CHN    | No more channels.  |
| RMS\$_NMF    | No more files.   |

Any condition value returned by RMS Parse and Search services, LIB\$GET\_VM, LIB\$GET\_VM\_64, LIB\$FREE\_VM, LIB\$FREE\_VM\_64, LIB\$SCOPY\_R\_DX, or LIB\$SCOPY\_R\_DX\_64.

---

## LIB\$FIND\_FILE\_END

### End of Find File

The End of Find File routine is called once after each sequence of calls to LIB\$FIND\_FILE. LIB\$FIND\_FILE\_END deallocates any saved Record Management Service (RMS) context and deallocates the virtual memory used to hold the allocated context block.

#### Format

LIB\$FIND\_FILE\_END context

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**context**  
OpenVMS usage: context  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Zero or the address of a FAB/NAM buffer from a previous call to LIB\$FIND\_FILE. The **context** argument is the address of a longword that contains this context.

#### Description

LIB\$FIND\_FILE\_END should be called by your program after each sequence of calls to LIB\$FIND\_FILE. This will prevent the default values from the previous call from affecting the next file specification.

LIB\$FIND\_FILE\_END deallocates the context used in the last call to LIB\$FIND\_FILE so that the context retained will not be used in subsequent calls to LIB\$FIND\_FILE. If LIB\$FIND\_FILE was directed to process file specifications for multiple input files, the saved file specifications are also deallocated.

#### Condition Values Returned

|             |   |
|-------------|---|
| SS\$_NORMAL | Routine successfully completed.                               |
| RMS\$_FAB   | File access block argument is not the address of a valid FAB. |

---

## LIB\$FIND\_IMAGE\_SYMBOL

### Find Universal Symbol in Shareable Image File

The Find Universal Symbol in Shareable Image File routine reads universal symbols from the shareable image file. This routine then dynamically activates a shareable image into the P0 address space of a process.

#### Format

LIB\$FIND\_IMAGE\_SYMBOL filename ,symbol ,symbol-value [,image-name]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### filename

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name of the file for which LIB\$FIND\_IMAGE\_SYMBOL is searching. The **filename** argument is the address of a descriptor pointing to this file name string. This argument may contain only the file name. File type cannot be indicated. If any file specification punctuation characters (:, [, <, ,, .) are present, the error SS\$\_IVLOGNAM is returned.

You can specify a file specification for the image name with the optional **image-name** argument. If you do not specify **image-name**, a default file specification of SYS\$SHARE:.EXE is applied to the file name. If the file is not in SYS\$SHARE:.EXE, a logical name must be used to direct this routine to locate the correct file. Only logical names defined in the system logical name table with the /EXEC attribute will be considered while the image activator is processing a request from an image that was installed with privileges. If the calling image was installed with privileges, the image being activated and any shareable images or message sections it references must be installed as a known image with the INSTALL utility. Running an image to which you have only Execute (not Read) access results in the same restrictions on logical names and shareable images as does running a privileged image.



On VAX systems, the **filename** descriptor must be class D, S, or Z. ♦

##### symbol

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Symbol for which LIB\$FIND\_IMAGE\_SYMBOL is searching in the **filename** file. The **symbol** argument is the address of a descriptor pointing to the symbol name

## LIB\$ Routines

### LIB\$FIND\_IMAGE\_SYMBOL

string. The symbol name string can be input in uppercase, lowercase, or mixed case letters.

#### symbol-value

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: write only  
mechanism: by reference

Symbol value that LIB\$FIND\_IMAGE\_SYMBOL has located. The **symbol-value** argument is the address of a signed longword integer into which LIB\$FIND\_IMAGE\_SYMBOL returns the symbol value. If the symbol is relocatable, the starting virtual address of the shareable image in memory will be added to the symbol value.

#### image-name

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Default file specification applied to the image name. The optional **image-name** argument is a string used as the RMS default file specification when parsing **filename** as the primary filename. If **image-name** is not supplied, then a default file specification of SYS\$SHARE:.EXE is applied to the image name.

**VAX**

On VAX systems, the **image-name** descriptor must be class D, S, or Z. ♦

## Description

The shareable image that LIB\$FIND\_IMAGE\_SYMBOL activates must have been already linked and must be position independent. You must have read access to the shareable image file to use this routine.

LIB\$FIND\_IMAGE\_SYMBOL writes the symbol value that it has located into the **symbol-value** argument.

After the first call to LIB\$FIND\_IMAGE\_SYMBOL for a particular image, successive calls for that image will be processed quickly. The image is activated only once and an in-memory database is maintained. There is no way to deallocate this database, nor is there any supported method to remove an activated image from the address space. All images are activated into P0 space.

LIB\$FIND\_IMAGE\_SYMBOL locates the universal symbol in its database qualified by the file name exactly as given in the **filename** argument. Therefore, a reference to a lexically different but equivalent file name causes a new copy of the same shareable image to be loaded and searched. To avoid this situation, *always specify the desired file name in the same form.*

**Alpha**

To interoperate properly with translated VAX images, LIB\$FIND\_IMAGE\_SYMBOL may modify the name of the file being searched and may retry the search if the first search failed. If called from a translated image, LIB\$FIND\_IMAGE\_SYMBOL will append “\_TV” to the file name before searching. This will locate the translated version of the image being searched. If the search fails to find the file or the file does not define the symbol, LIB\$FIND\_IMAGE\_SYMBOL tries again with the unmodified original file name. This will locate the native Alpha version of the image. If the second search also fails, an error is returned. If LIB\$FIND\_IMAGE\_SYMBOL is called from a native Alpha program, the order

of the searches is reversed. The first search is done with the unmodified original file name. If that fails, the second search is done with “\_TV” appended to the file name. If the second search fails, an error is returned. ♦

LIB\$FIND\_IMAGE\_SYMBOL disables AST recognition while it is executing. AST recognition is reenabled before returning to the caller only if AST recognition was previously enabled.

LIB\$FIND\_IMAGE\_SYMBOL signals all errors and returns the status in R0.

### Condition Values Returned

|   |   |
|---|---|
| LIB\$_BADCCC  | Illegal compilation code.   |
| LIB\$_EOMERROR  | Compilation errors.   |
| LIB\$_EOMFATAL  | Fatal compilation errors.   |
| LIB\$_EOMWARN   | Compilation warnings.   |
| LIB\$_GSDTYP  | Illegal universal symbol directory record type.   |
| LIB\$_ILLFMLCNT   | Maximum argument count exceeds maximum for routine.   |
| LIB\$_ILLMODNAM   | Illegal module name length.   |
| LIB\$_ILLPSCLEN   | Illegal program section length.   |
| LIB\$_ILLRECLN  | Illegal record length in module.  |
| LIB\$_ILLRECLN2   | Illegal record length.  |
| LIB\$_ILLRECTYP   | Illegal record type in module.  |
| LIB\$_ILLRECTY2   | Illegal record type.  |
| LIB\$_ILLSYMLN  | Illegal symbol length.  |
| LIB\$_NOEOM   | No end of module record contained in the module.  |
| LIB\$_RECTOOSML   | Record too small; data overflows object record in module.   |
| LIB\$_SEQUENCE  | Illegal record sequence in module.  |
| LIB\$_SEQUENCE2   | Illegal record sequence.  |
| LIB\$_STRVL   | Illegal object language structure level in module.  |
| Note that all of the above error messages indicate a format error in the shareable image. |   |
| LIB\$_INSVIRMEM   | Insufficient virtual memory.  |
| SS\$_IVLOGNAM   | The <b>filename</b> argument contained more than just a file name; a device or directory specification was found in the string. |

Any condition values returned by LIB\$INSERT\_TREE.

Any condition values returned by LIB\$LOOKUP\_TREE.

Any condition values returned by RMS.

---

## LIB\$FIND\_VM\_ZONE

### Return the Next Valid Zone Identifier

The Return the Next Valid Zone Identifier routine returns the zone identifier of the next valid zone in the heap management 32-bit database.

#### Format

LIB\$FIND\_VM\_ZONE context ,zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context specifier. The **context** argument is the address of an unsigned longword used to keep the scan context for finding the next valid zone. The **context** argument must be 0 to initialize the scan and to start with the first returnable zone identifier.

##### zone-id

OpenVMS usage: identifier  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Zone identifier. The **zone-id** argument is the address of an unsigned longword that receives the zone identifier for the next zone.

#### Description

At each call, LIB\$FIND\_VM\_ZONE scans the heap management 32-bit zone database and returns the **zone-id** of the next valid zone. (The first and second calls to LIB\$FIND\_VM\_ZONE return the **zone-id** of the 32-bit default zone and the 32-bit string zone, respectively.) This capability allows a program to deal with each 32-bit VM zone created during the invocation, including those created outside of the program.

---

#### Note

LIB\$FIND\_VM\_ZONE finds only 32-bit zones. You must use LIB\$FIND\_VM\_ZONE and LIB\$FIND\_VM\_ZONE\_64 to loop through all VM zones.

---

## LIB\$ Routines LIB\$FIND\_VM\_ZONE

The **context** argument controls the state of the scan. It determines what zone to return (the first, the next, and so forth). On the initial call, specified by **context=0**, LIB\$VERIFY\_VM\_ZONE is called to verify the heap management zone database. If the database is corrupt, further calls to this routine will produce no additional useful output.

When no more zones can be found, the routine returns the condition value LIB\$\_NOTFOU.

If a zone has been corrupted in some major way (for example, if the validity code has been changed), then this routine may not be able to locate it in the zone database.

Note that ASTs may be disabled while LIB\$FIND\_VM\_ZONE is executing code that depends on the stability of the heap management zone database. In general it is the caller's responsibility to ensure that the calling program has exclusive access to the zone database while scanning for multiple zones with this routine. Results are unpredictable if another thread of control modifies the zone database or the associated areas during the scanning.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.                       |
| LIB\$_BADZONE   | Invalid zone.   |
| LIB\$_NOTFOU    | Zone identifier not found (alternate success status). |
| LIB\$_WRONUMARG | Wrong number of arguments.                            |

### Example

```
IMPLICIT NONE
INTEGER*4 status,context,zone_id
INTEGER*4 lib$find_vm_zone,lib$show_vm_zone

context = 0
status = lib$find_vm_zone (context, zone_id)
DO WHILE (status)
  print *
  status = lib$show_vm_zone (zone_id, 0)
  status = lib$find_vm_zone (context, zone_id)
END DO
END
```

Sample output for this Fortran program is shown below:

```
Zone Id = 00020020, Zone name = "DEFAULT_ZONE"
Zone Id = 000200B0, Zone name = "STRING_ZONE"
```

## LIB\$ Routines

### LIB\$FIND\_VM\_ZONE\_64 (Alpha Only)

---

## LIB\$FIND\_VM\_ZONE\_64 (Alpha Only)

### Return the Next Valid Zone Identifier

The Return the Next Valid Zone Identifier routine returns the zone identifier of the next valid zone in the heap management 64-bit database.

#### Format

LIB\$FIND\_VM\_ZONE\_64 context ,zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### context

OpenVMS usage: context  
type: quadword (unsigned)  
access: modify  
mechanism: by reference

Context specifier. The **context** argument is the address of an unsigned quadword used to keep the scan context for finding the next valid zone. The **context** argument must be 0 to initialize the scan and to start with the first returnable zone identifier.

##### zone-id

OpenVMS usage: identifier  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Zone identifier. The **zone-id** argument is the address of an unsigned quadword that receives the zone identifier for the next zone.

#### Description

At each call, LIB\$FIND\_VM\_ZONE\_64 scans the heap management 64-bit zone database and returns the **zone-id** of the next valid zone. (The first and second calls to LIB\$FIND\_VM\_ZONE\_64 return the **zone-id** of the 64-bit default zone and the 64-bit string zone, respectively.) This capability allows a program to deal with each VM 64-bit zone created during the invocation, including those created outside of the program.

---

#### Note

LIB\$FIND\_VM\_ZONE\_64 finds only 64-bit zones. You must use LIB\$FIND\_VM\_ZONE and LIB\$FIND\_VM\_ZONE\_64 to loop through all VM zones.

---

## LIB\$ Routines LIB\$FIND\_VM\_ZONE\_64 (Alpha Only)

The **context** argument controls the state of the scan. It determines what zone to return (the first, the next, and so forth). On the initial call, specified by **context=0**, LIB\$VERIFY\_VM\_ZONE\_64 is called to verify the heap management zone database. If the database is corrupt, further calls to this routine will produce no additional useful output.

When no more zones can be found, the routine returns the condition value LIB\$\_NOTFOU.

If a zone has been corrupted in some major way (for example, if the validity code has been changed), then this routine may not be able to locate it in the zone database.

Note that ASTs may be disabled while LIB\$FIND\_VM\_ZONE\_64 is executing code that depends on the stability of the heap management zone database. In general it is the caller's responsibility to ensure that the calling program has exclusive access to the zone database while scanning for multiple zones with this routine. Results are unpredictable if another thread of control modifies the zone database or the associated areas during the scanning.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.                       |
| LIB\$_BADZONE   | Invalid zone.   |
| LIB\$_NOTFOU    | Zone identifier not found (alternate success status). |
| LIB\$_WRONUMARG | Wrong number of arguments.                            |

### Example

```
IMPLICIT NONE
INTEGER*4 status
INTEGER*8 context,zone_id
INTEGER*4 lib$find_vm_zone_64,lib$show_vm_zone_64

context = 0
status = lib$find_vm_zone_64 (context, zone_id)
DO WHILE (status)
  print *
  status = lib$show_vm_zone_64 (zone_id, 0)
  status = lib$find_vm_zone_64 (context, zone_id)
END DO
END
```

Sample output for this Fortran program is as follows:

```
Zone Id = 000000000020040, Zone name = "DEFAULT_ZONE"
Zone Id = 000000000020140, Zone name = "STRING_ZONE"
```

## LIB\$FIT\_NODENAME

### Fit a Node Name into an Output Field

The Fit a Node Name Into an Output Field routine fits a node name into an output field. It attempts to compress the node name to fit the output field. If this fails, it trims the node name.†

#### Format

LIB\$FIT\_NODENAME nodename, output-buffer [,output-width] [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **nodename**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Node name to be fitted into the desired output field. The **nodename** argument contains the address of a descriptor pointing to this node-name string.

The error LIB\$\_INVARG is returned if **nodename** contains an invalid node name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if **nodename** is an invalid descriptor.

##### **output-buffer**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

The output buffer. The **output-buffer** argument contains the address of a descriptor pointing to the output buffer. LIB\$FIT\_NODENAME writes the final output node name into the buffer pointed to by **output-buffer**.

The error LIB\$\_INVSTRDES is returned if **output-buffer** is an invalid descriptor.

The length field of the **output-buffer** descriptor is not updated unless **output-buffer** is a dynamic descriptor with a length less than the resulting fitted node name. Refer to the *OpenVMS RTL String Manipulation (STR\$) Manual* for dynamic string descriptor usage.

The **output-buffer** argument contains an unusable result when LIB\$FIT\_NODENAME returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

### **output-width**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Field width desired for the fit operation. The **output-width** argument is the address of an unsigned word that contains this field width in bytes.

If **output-width** is omitted, the current length of **output-buffer** is used. If **output-buffer** is not a fixed-length string, specify **output-width** to ensure that the desired width is used.

If the lengths of both **output-buffer** and **output-width** are specified, the length in **output-width** is used. In this case, if the current length of **output-buffer** is smaller than the length of **output-width**, the output node name is truncated at the end, and the alternate successful status LIB\$\_STRTRU is returned.

### **resultant-length**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the output node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB\$FIT\_NODENAME returns in error.

## **Description**

This routine fits the input node name into the desired output field for display purposes. It first attempts to get the usable short form of the input node name by calling LIB\$COMPRESS\_NODENAME. If that fails, the input node name is expanded by LIB\$EXPAND\_NODENAME and then trimmed by LIB\$TRIM\_FULLNAME to fit the desired output width.

The input is validated against the supported form of input node names. The error LIB\$\_INVARG is returned if the input node name is invalid.

Node-name compression is always attempted even if the length of the input node name is less than or equal to the desired output width. This is to ensure that the short form of a full name is always chosen for display purposes.

When the compressed node name is too long to fit the desired output width, the input node name is expanded using LIB\$EXPAND\_NODENAME and trimmed using LIB\$TRIM\_FULLNAME. In this case, the alternate success status LIB\$\_STRTRU is returned.

When LIB\$FIT\_NODENAME encounters errors from the underlying network services, it tries to return the string-truncated compressed node name. If it is the compression operation that fails, LIB\$FIT\_NODENAME returns the string-truncated input node name. The alternate successful status LIB\$\_STRTRU is returned.

## LIB\$ Routines

### LIB\$FIT\_NODENAME

Note that the returned node name can be either a compressed usable short form of the input node name or an unusable trimmed or truncated node name. The caller should always assume an unusable node name is returned when it finds the alternate success return status LIB\$\_STRTRU. On the other hand, the SS\$\_NORMAL return status means that a usable form of a node name is returned.

LIB\$FIT\_NODENAME adds padding spaces to the end of the output buffer if the output node name is shorter than the size of the output buffer. The argument **resultant-length**, if supplied, is set to the length of the output node name, excluding any padding spaces.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Routine successfully completed. Characters are truncated in the output buffer pointed to by <b>output-buffer</b> .   |
| LIB\$_INVARG    | Invalid argument: <ul style="list-style-type: none"><li>• <b>nodename</b> is invalid.</li><li>• <b>nodename</b> points to a null string.</li><li>• The length of the node name is more than 1024 characters.</li></ul> |
| LIB\$_INVSTRDES | Invalid string descriptor.   |
| LIB\$_WRONUMARG | Wrong number of arguments.   |

Any condition value returned by LIB\$SCOPY\_R\_DX.

---

## LIB\$FIXUP\_FLT

### Fix Floating Reserved Operand

The Fix Floating Reserved Operand routine finds the reserved operand of any F-floating, D-floating, G-floating, or H-floating instruction (with some exceptions) after a reserved operand fault has been signaled.† LIB\$FIXUP\_FLT changes the reserved operand from -0.0 to the value of the **new-operand** argument, if present; or to +0.0 if **new-operand** is absent.

**Alpha**

This routine is available on OpenVMS Alpha systems in translated form and is applicable to translated VAX images only. ♦

#### Format

LIB\$FIXUP\_FLT signal-arguments ,mechanism-arguments [,new-operand]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### signal-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Signal argument vector. The **signal-arguments** argument is the address of an array of unsigned longwords containing the signal argument vector.

##### mechanism-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Mechanism argument vector. The **mechanism-arguments** argument is the address of an array of unsigned longwords containing the mechanism argument vector.

##### new-operand

OpenVMS usage: floating-point  
type: F\_floating  
access: read only  
mechanism: by reference

An F-floating value to replace the reserved operand. The **new-operand** argument is the address of an F-floating number containing the new operand. This is an optional argument. If omitted, the default value is +0.0.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$FIXUP\_FLT

#### Description

LIB\$FIXUP\_FLT finds the reserved operand of any F-floating, D-floating, G-floating, or H-floating instruction (with some exceptions) after a reserved operand fault has been signaled. LIB\$FIXUP\_FLT changes the reserved operand from -0.0 to the value of the **new-operand** argument, if present; or to +0.0 if **new-operand** is absent. LIB\$FIXUP\_FLT cannot handle the following cases and will return a status of SS\$\_RESIGNAL if any of them occur:

- The currently active signaled condition is not SS\$\_ROPRAND.
- The reserved operand's data type is not F-floating, D-floating, G-floating, or H-floating.
- The reserved operand is an element in the coefficient table for one of the VAX POLY $x$  instructions.

If the status value returned from LIB\$FIXUP\_FLT is seen by the condition handling facility (as would be the case if LIB\$FIXUP\_FLT was the handler), any success value is equivalent to SS\$\_CONTINUE, which causes the instruction to be restarted. Any failure value is equivalent to SS\$\_RESIGNAL, which causes the condition to be resignaled to the next handler. This resignal status is because the condition handler (LIB\$FIXUP\_FLT) was unable to handle the condition correctly.

LIB\$FIXUP\_FLT can be enabled directly as a condition handler. The **signal-arguments** and **mechanism-arguments** arguments are passed to the condition handler by OpenVMS exception dispatching.

#### Condition Values Returned

|               |  |
|---------------|--|
| SS\$_NORMAL   | Routine successfully completed. The reserved operand was found and has been fixed.   |
| SS\$_ACCVIO   | Access violation. An argument to LIB\$FIXUP_FLT or an operand of the faulting instruction could not be read or written.                    |
| SS\$_RESIGNAL | The signaled condition was not SS\$_ROPRAND, or the reserved operand was not a floating-point value or was an element in a POLY $x$ table. |
| SS\$_ROPRAND  | Reserved operand fault. The optional argument <b>new-operand</b> was supplied but was itself an F-floating reserved operand.               |
| LIB\$_BADSTA  | Bad stack. The stack frame linkage has been corrupted since the time of the reserved operand exception.                                    |

---

## LIB\$FLT\_UNDER

### Floating-Point Underflow Detection

The Floating-Point Underflow Detection routine enables or disables floating-point underflow detection for the calling routine activation. The previous setting is returned as a function value.†



This routine is available on OpenVMS Alpha systems in translated form and is applicable to translated VAX images only. ♦

#### Format

LIB\$FLT\_UNDER new-setting

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The old floating-point underflow enable setting (the previous contents of the SF\$W\_PSW[PSW\$V\_FU] in the caller's frame).

#### Argument

##### new-setting

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

New floating-point underflow enable setting. The **new-setting** argument is the address of an unsigned byte containing the new setting. Bit 0 set to 1 means enable; bit 0 set to 0 means disable.

#### Description

LIB\$FLT\_UNDER affects only the current routine activation and does not affect any of its callers or any routines that it may call. However, the setting does remain in effect for any routines entered through a JSB entry point.

The caller's stack frame will be modified by this routine.

#### Condition Values Returned

None.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines LIB\$FLT\_UNDER

### Example

```
C+
C This Fortran example program shows
C the use of LIB$FLT_UNDER.
C-

      INTEGER*4 NEW_SETTING
      REAL*4 X , Y , Z

      NEW_SETTING = 0
      X = 1E-20
      Y = 1E20

      CALL LIB$FLT_UNDER( NEW_SETTING )

      TYPE * , 'First Case: This should not have an underflow exception'
      Z = X / Y

      TYPE * , 'If this lines prints then the underflow exception
1 was disabled.'
      TYPE *

      NEW_SETTING = 1
      X = 1E-20
      Y = 1E20

      CALL LIB$FLT_UNDER( NEW_SETTING )

      TYPE * , 'Second Case: This should have an underflow exception
1 and then stop.'
      Z = X / Y

      TYPE * , 'If this line prints, then the underflow exception
1 was disabled.'

      END
```

In this Fortran example, floating-point underflow detection is disabled the first time X is divided by Y. The second time, underflow detection is enabled, and the program stops because of the error generated.

---

## LIB\$FORMAT\_DATE\_TIME

### Format Date and/or Time

The Format Date and/or Time routine allows the user to select at run time a specific output language and format for a date or time, or both.

#### Format

LIB\$FORMAT\_DATE\_TIME *date-string* [,*date*] [,*user-context*] [,*date-length*] [,*flags*]

#### Returns

OpenVMS usage: *cond\_value*  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **date-string**

OpenVMS usage: *char\_string*  
type: character string  
access: write only  
mechanism: by descriptor

Receives the requested date or time, or both, that has been formatted for output according to the currently selected format and language. The **date-string** argument is the address of a descriptor pointing to this string.

##### **date**

OpenVMS usage: *date\_time*  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

The date or time, or both, to be formatted for output. The **date** argument is the address of an unsigned quadword that contains the absolute date or time, or both to be formatted. If you omit this argument, or if you supply a zero passed by value, then the current system time is used. Note that the **date** argument must represent an absolute time, not a delta time.

##### **user-context**

OpenVMS usage: *context*  
type: longword (unsigned)  
access: modify  
mechanism: by reference

User context that retains the translation context over multiple calls to this routine. The **user-context** argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

The **user-context** parameter is optional. However, if a context cell is not passed, the routine LIB\$FORMAT\_DATE\_TIME may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level,

## LIB\$ Routines

### LIB\$FORMAT\_DATE\_TIME

Digital recommends that users specify a different context cell for each calling thread.

#### **date-length**

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: write only  
mechanism: by reference

Number of bytes of text written to the **date-string** argument. The **date-length** argument is the address of a signed longword that receives this string length. Note that **date-length** specifies the number of bytes of text, not the number of characters, written to **date-string**.

#### **flags**

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Bit mask that allows the user to specify whether the date, time, or both are output. The **flags** argument is the address of an unsigned bit mask containing the specified values. Valid values are LIB\$M\_DATE\_FIELDS and LIB\$M\_TIME\_FIELDS.

Default values are determined as follows:

- If the **flags** argument is omitted, LIB\$FORMAT\_DATE\_TIME determines which fields to format according to the current definition of LIB\$DT\_FORMAT.
- If the **flags** argument is specified, LIB\$FORMAT\_DATE\_TIME uses the **flags** value to determine which fields to format. That is, the **flags** argument can be used to override the definition of LIB\$DT\_FORMAT when specifying which fields should be formatted for output. If the field specified by **flags** was not assigned a format through the definition of LIB\$DT\_FORMAT, the standard OpenVMS format is used.

## Description

The LIB\$FORMAT\_DATE\_TIME routine formats an OpenVMS internal format date-time quadword into a textual string of some predefined format. The language to be used and the format in which to output the information are programmable using either of the following methods.

- The language and format are programmable at compile time through the use of the routine LIB\$INIT\_DATE\_TIME\_CONTEXT.
- The language and format are determined at run time through the translation of the logical names SYS\$LANGUAGE and LIB\$DT\_FORMAT.

In general, if an application is formatting text for internal storage or transmission, the language and format should be specified at compile time. If this is the case, use the routine LIB\$INIT\_DATE\_TIME\_CONTEXT to specify the language and format of your choice.

## LIB\$ Routines LIB\$FORMAT\_DATE\_TIME

If an application is formatting text for presentation to a user, the logical name method of specifying language and format should be used. In this method, the user assigns equivalence names to the logical names `SYS$LANGUAGE` and `LIB$DT_FORMAT`, thereby selecting the language and format of the date and time at run time.

If the logical name method is used, the translations of the logical names `SYS$LANGUAGE` and `LIB$DT_FORMAT` specify one or more executive mode logicals, which in turn must be translated to determine the actual format string. These additional logicals supply such things as the names of the days of the week and the months in the selected language (determined by `SYS$LANGUAGE`). All of these logicals are predefined, so that a non-privileged user can select any one of these languages and formats. A user can create his or her own languages and formats; however, the `CMEEXEC`, `SYSNAME`, and `SYS$PRV` privileges are required.

With the exception of `SYS$LANGUAGE` and `LIB$DT_FORMAT`, all logical names used by this routine must be defined from the executive mode.

See the *OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

### Condition Values Returned

|                               |  |
|-------------------------------|--|
| <code>SS\$_NORMAL</code>      | Routine successfully completed.                                  |
| <code>LIB\$_ENGLUSED</code>   | English used; unable to determine or use the specified language. |
| <code>LIB\$_DEFFORUSE</code>  | Default format used; unable to determine the desired format.     |
| <code>LIB\$_UNRFORCOD</code>  | Unrecognized format code.  |
| <code>LIB\$_STRTRU</code>     | Output string truncated.   |
| <code>LIB\$_ABSTIMREQ</code>  | Absolute time required.  |
| <code>LIB\$_REENTRANCY</code> | Reentrant invocation with same context variable.                 |

Any condition values returned by `SYS$NUMTIM`, `LIB$GET_VM`, `LIB$GET_VM_64`, and `LIB$ANALYZE_SDESC`, `LIB$ANALYZE_SDESC_64`.

## LIB\$FORMAT\_SOGW\_PROT (VAX Only) Format Protection Mask

The Format Protection Mask routine translates a protection mask into a formatted string.

### Format

LIB\$FORMAT\_SOGW\_PROT protection-mask, [access-names], [ownership-names],  
[ownership-separator], [list-separator], protection-string, [protection-length]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### protection-mask

OpenVMS usage: protection  
type: word (unsigned)  
access: read only  
mechanism: by reference

The **protection-mask** argument is the address of a word that holds a 16-bit protection mask to be translated.

#### access-names

OpenVMS usage: access\_names  
type: array [0..31] of quadword string descriptor  
access: read only  
mechanism: by reference

The **access-names** argument is the address of the access name table for the associated object class. For example, it is the value returned by the LIB\$GET\_ACCNAM routine in the "accnam" longword. This parameter is optional and defaults to the access name table for the FILE object class.

#### ownership-names

OpenVMS usage: char\_string  
type: array [0..3] of quadword string descriptor  
access: read only  
mechanism: by reference

The **ownership-names** argument is the address of a vector of 4 quadword descriptors that points to the ownership name. The default value is the full ownership category names (System, Owner, Group, World).

#### **ownership-separator**

OpenVMS usage: char\_string  
type: character-coded text string  
access: read only  
mechanism: by descriptor

The **ownership-separator** argument is the address of a descriptor that points to the ownership separator string. The separator string is inserted after the ownership name to introduce a nonempty set of access names. By default, the value is " " (the colon and space characters).

#### **list-separator**

OpenVMS usage: char\_string  
type: character-coded text string  
access: read only  
mechanism: by descriptor

The **list-separator** argument is the address of a descriptor that points to the list separator string. The list separator string is inserted between ownership-access type pairs. By default, the value is ", " (the comma and space characters).

#### **protection-string**

OpenVMS usage: char\_string  
type: character-coded text string  
access: write only  
mechanism: by descriptor

The **protection-string** argument is the address of a character-string descriptor that receives the output of the routine call. **protection-string** points to the formatted protection string at the end of a call. The protection string has the following components repeated for each of: System, Owner, Group, World:

ownership-name[ownership-separator][access-types][list-separator].

An example of a formatted protection string is

System: RWED, Owner: RWED, Group: RW, World: R

#### **protection-length**

OpenVMS usage: word\_signed  
type: word (signed)  
access: write only  
mechanism: by reference

The **protection-length** argument is the address of a word that receives the length of the string returned in the **protection-string** argument.

## **Description**

LIB\$FORMAT\_SOGW\_PROT translates a 16-bit protection mask into a formatted string. This routine works for any protected object class by specifying the correct access name table. The address of the access name table can be obtained from the LIB\$GET\_ACCNAM routine.

Several formatting options are available. The caller can specify ownership names, ownership separators, or list separators.

**LIB\$ Routines**  
**LIB\$FORMAT\_SOGW\_PROT (VAX Only)**

**Condition Values Returned**

|                   |                                 |
|-------------------|---------------------------------|
| SS\$_NORMAL       | Routine successfully completed. |
| LIB\$_INVARG      | Required parameter missing.     |
| STR\$_TRU         | String truncation warning.      |
| LIB\$_WRONGNUMARG | Wrong number of arguments.      |

---

## LIB\$FREE\_DATE\_TIME\_CONTEXT

### Free the Context Area Used When Formatting Dates and Times for Input or Output

The Free the Context Area Used When Formatting Dates and Times for Input or Output routine frees the virtual memory associated with the context area used by the date/time input and output Formatting Routines.

#### Format

LIB\$FREE\_DATE\_TIME\_CONTEXT [user-context]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**user-context**  
OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

User context that retains the translation context over multiple calls to the date /time input and output Formatting Routines. The **user-context** argument is the address of an unsigned longword that contains this context. If the **user-context** argument was not specified in the call to LIB\$FORMAT\_DATE\_TIME, LIB\$CONVERT\_DATE\_STRING, or LIB\$GET\_MAXIMUM\_DATE\_LENGTH, then no argument should be supplied when calling this routine.

#### Description

The LIB\$FREE\_DATE\_TIME\_CONTEXT routine frees the virtual memory associated with the context area used by the date/time input and output formatting routines. A call to this routine is optional, since the same functions are performed at image exit.

#### Condition Values Returned

SS\$NORMAL                      Routine successfully completed.

Any condition value returned by LIB\$FREE\_VM. If one of these condition values is returned, it indicates either an internal coding error or that memory was corrupted by the user's program.

## LIB\$FREE\_EF Free Event Flag

The Free Event Flag routine frees a local event flag previously allocated by LIB\$GET\_EF. LIB\$FREE\_EF is the complement of LIB\$GET\_EF.

### Format

LIB\$FREE\_EF event-flag-number

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Argument

#### event-flag-number

OpenVMS usage: ef\_number  
type: longword integer (unsigned)  
access: read only  
mechanism: by reference

Event flag number to be deallocated by LIB\$FREE\_EF. The **event-flag-number** argument is the address of a signed longword integer that contains the event flag number, which is the value returned to the user by LIB\$GET\_EF.

### Description

When a local event flag allocated by calling LIB\$GET\_EF is no longer needed, LIB\$FREE\_EF should be called to free the event flag for use by other routines.

### Condition Values Returned

|                  |  |
|------------------|--|
| SS\$ _NORMAL     | Routine successfully completed.  |
| LIB\$ _EF_ALRFRE | Event flag already free.   |
| LIB\$ _EF_RESSYS | Event flag reserved to system. This error occurs if the event flag number is outside the ranges of 1 to 23 and 32 to 63. |

---

## LIB\$FREE\_LUN

### Free Logical Unit Number

The Free Logical Unit Number routine releases a logical unit number allocated by LIB\$GET\_LUN to the pool of available numbers. LIB\$FREE\_LUN is the complement of LIB\$GET\_LUN.

#### Format

LIB\$FREE\_LUN logical-unit-number

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**logical-unit-number**  
OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Logical unit number to be deallocated. The **logical-unit-number** argument is the address of a signed longword integer that contains this logical unit number, which is the value previously returned by LIB\$GET\_LUN.

#### Description

When a logical unit number allocated by calling LIB\$GET\_LUN is no longer needed, it should be released for use by other routines.

This routine is useful only in BASIC or Fortran programs.

#### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_LUNALRFRE | Logical unit number is already free.  |
| LIB\$_LUNRESSYS | Logical unit number reserved to system. This occurs if the specified logical unit number is outside the range of 100 through 299. |

---

## LIB\$FREE\_TIMER

### Free Timer Storage

The Free Timer Storage routine frees the storage allocated by LIB\$INIT\_TIMER.

#### Format

LIB\$FREE\_TIMER handle-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**handle-address**  
OpenVMS usage: address  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Pointer to a block of storage containing the value returned by a previous call to LIB\$INIT\_TIMER; this is the storage that LIB\$FREE\_TIMER deallocates. The **handle-address** argument is the address of an unsigned longword containing that value.

#### Description

LIB\$FREE\_TIMER frees a block of storage previously allocated by LIB\$INIT\_TIMER. LIB\$FREE\_TIMER assumes that **handle-address** was returned by a previous call to LIB\$INIT\_TIMER. If the block referred to by **handle-address** was not allocated by LIB\$INIT\_TIMER, LIB\$FREE\_TIMER returns an error. If the routine completes successfully, LIB\$FREE\_TIMER sets **handle-address** to zero.

#### Condition Values Returned

|                |  |
|----------------|--|
| SS\$NORMAL     | Routine successfully completed.  |
| LIB\$INVARG    | Invalid argument; <b>handle-address</b> was not supplied or did not point to a timer block.              |
| LIB\$BADBLOADR | Bad block address; LIB\$FREE_TIMER could not deallocate the block to which <b>handle-address</b> points. |

---

## LIB\$FREE\_VM

### Free Virtual Memory from Program Region

The Free Virtual Memory from Program Region routine deallocates an entire block of contiguous bytes that were allocated by a previous call to LIB\$GET\_VM. The arguments passed are the same as for LIB\$GET\_VM.†

#### Format

LIB\$FREE\_VM number-of-bytes ,base-address [,zone-id]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-bytes

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of contiguous bytes to be deallocated by LIB\$FREE\_VM. The **number-of-bytes** argument is the address of a signed longword integer that contains this number. The value of **number-of-bytes** must be greater than zero.

Byte counts are rounded in the same manner as in LIB\$GET\_VM.

---

#### Note

---

You may omit the **number-of-bytes** argument if you are using boundary tags (LIB\$M\_VM\_BOUNDARY\_TAGS).

---

##### base-address

OpenVMS usage: address  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Address of the first byte to be deallocated by LIB\$FREE\_VM. The **base-address** argument contains the address of an unsigned longword that is this address. The value of **base-address** must be the address of a block of memory that was allocated by a previous call to LIB\$GET\_VM.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$FREE\_VM

#### zone-id

OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The **zone-id** argument is the address of a longword that contains a zone identifier created by a previous call to LIB\$CREATE\_VM\_ZONE or LIB\$CREATE\_USER\_VM\_ZONE.

You must specify the same **zone-id** value as when you called LIB\$GET\_VM to allocate the block. An error status will be returned if you specify an incorrect **zone-id**. The **zone-id** argument is optional. If **zone-id** is omitted or if the longword contains the value 0, LIB\$VM's 32-bit default zone is used.

## Description

LIB\$FREE\_VM returns the block of memory to a free list associated with the zone, so the block is available on a subsequent call to LIB\$GET\_VM for the zone.

The **base-address** argument must contain the address of the first byte of memory that was allocated by a previous call to LIB\$GET\_VM. LIB\$FREE\_VM rounds up the value of **number-of-bytes** to a multiple of the block size for the zone.

---

#### Note

---

You cannot free part of a block that was allocated by a call to LIB\$GET\_VM. The whole block must be freed by a single call to LIB\$FREE\_VM.

Neither can you combine contiguous blocks of memory that were allocated by several calls to LIB\$GET\_VM into one larger block that is freed by a single call to LIB\$FREE\_VM.

---

If you specified deallocation filling when you created the zone, LIB\$FREE\_VM will fill each byte freed. Note that part of a free block is used to store control information, so some bytes will not contain the fill value.

LIB\$FREE\_VM is fully reentrant, so it can be called by routines executing at AST-level or in an Ada multitasking environment.

If the zone you are freeing was created using the LIB\$CREATE\_USER\_VM\_ZONE routine, then you must have an appropriate action routine for the free operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE, you must have specified a user deallocation procedure.

## Condition Values Returned

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_BADBLOADR

The **base-address** argument contained a bad block address. Either an address was outside of the area allocated by LIB\$GET\_VM, the contents of **base-address** were not properly aligned, part of the space being deallocated was previously deallocated, or a zone was found to be corrupt.

**LIB\$\_BADBLOSIZ**

The **number-of-bytes** argument is less than or equal to 0, or the **number-of-bytes** argument is incorrect for a zone containing fixed size blocks.

**LIB\$\_BADTAGVAL**

For a zone that uses boundary tags, the tag field was corrupted.

## LIB\$ Routines

### LIB\$FREE\_VM\_64 (Alpha Only)

---

## LIB\$FREE\_VM\_64 (Alpha Only)

### Free Virtual Memory from Program Region

The Free Virtual Memory from Program Region routine deallocates an entire block of contiguous bytes that were allocated by a previous call to LIB\$GET\_VM\_64. The arguments passed are the same as for LIB\$GET\_VM\_64.

#### Format

LIB\$FREE\_VM\_64 number-of-bytes ,base-address [,zone-id]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-bytes

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Number of contiguous bytes to be deallocated by LIB\$FREE\_VM\_64. The **number-of-bytes** argument is the address of a signed quadword integer that contains this number. The value of **number-of-bytes** must be greater than zero.

Byte counts are rounded in the same manner as in LIB\$GET\_VM\_64.

---

#### Note

---

You may omit the **number-of-bytes** argument if you are using boundary tags (LIB\$M\_VM\_BOUNDARY\_TAGS).

---

##### base-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Address of the first byte to be deallocated by LIB\$FREE\_VM\_64. The **base-address** argument contains the address of an unsigned quadword that is this address. The value of **base-address** must be the address of a block of memory that was allocated by a previous call to LIB\$GET\_VM\_64.

**zone-id**

OpenVMS usage: identifier  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

The **zone-id** argument is the address of a quadword that contains a zone identifier created by a previous call to LIB\$CREATE\_VM\_ZONE\_64 or LIB\$CREATE\_USER\_VM\_ZONE\_64.

You must specify the same **zone-id** value as when you called LIB\$GET\_VM\_64 to allocate the block. An error status will be returned if you specify an incorrect **zone-id**. The **zone-id** argument is optional. If **zone-id** is omitted or if the quadword contains the value 0, LIB\$VM's 64-bit default zone is used.

## Description

LIB\$FREE\_VM\_64 returns the block of memory to a free list associated with the zone, so the block is available on a subsequent call to LIB\$GET\_VM\_64 for the zone.

The **base-address** argument must contain the address of the first byte of memory that was allocated by a previous call to LIB\$GET\_VM\_64. LIB\$FREE\_VM\_64 rounds up the value of **number-of-bytes** to a multiple of the block size for the zone.

---

### Note

---

You cannot free part of a block that was allocated by a call to LIB\$GET\_VM\_64. The whole block must be freed by a single call to LIB\$FREE\_VM\_64.

Neither can you combine contiguous blocks of memory that were allocated by several calls to LIB\$GET\_VM\_64 into one larger block that is freed by a single call to LIB\$FREE\_VM\_64.

---

If you specified deallocation filling when you created the zone, LIB\$FREE\_VM\_64 will fill each byte freed. Note that part of a free block is used to store control information, so some bytes will not contain the fill value.

LIB\$FREE\_VM\_64 is fully reentrant, so it can be called by routines executing at AST-level or in an Ada multitasking environment.

If the zone you are freeing was created using the LIB\$CREATE\_USER\_VM\_ZONE\_64 routine, then you must have an appropriate action routine for the free operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE\_64, you must have specified a user deallocation procedure.

**LIB\$ Routines**  
**LIB\$FREE\_VM\_64 (Alpha Only)**

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_BADBLOADR

The **base-address** argument contained a bad block address. Either an address was outside of the area allocated by LIB\$GET\_VM\_64, the contents of **base-address** were not properly aligned, part of the space being deallocated was previously deallocated, or a zone was found to be corrupt.

LIB\$\_BADBLOSIZ

The **number-of-bytes** argument is less than or equal to 0, or the **number-of-bytes** argument is incorrect for a zone containing fixed size blocks.

LIB\$\_BADTAGVAL

For a zone that uses boundary tags, the tag field was corrupted.

---

## LIB\$FREE\_VM\_PAGE

### Free Virtual Memory Page

The Free Virtual Memory Page routine deallocates a block of contiguous pages on VAX systems or pagelets on Alpha systems that were allocated by previous calls to LIB\$GET\_VM\_PAGE.†

#### Format

LIB\$FREE\_VM\_PAGE number-of-pages ,base-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-pages

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of pages on VAX systems or pagelets on Alpha systems. The **number-of-pages** argument is the address of a longword integer which specifies the number of contiguous pages on VAX systems or pagelets on Alpha systems to be deallocated. The value of **number-of-pages** must be greater than zero.

##### base-address

OpenVMS usage: address  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Block address. The **base-address** argument is the address of a longword which contains the address of the first byte of the first VAX page or Alpha pagelet to be deallocated.

#### Description

LIB\$FREE\_VM\_PAGE deallocates a block of contiguous 512-byte pages starting at **base-address**. Each of the pages or pagelets specified by **number-of-pages** and **base-address** must have been allocated by previous calls to LIB\$GET\_VM\_PAGE. The pages or pagelets are returned to the processwide pool and are available to satisfy subsequent calls to LIB\$GET\_VM\_PAGE.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$FREE\_VM\_PAGE

You can free a smaller group of pages or pagelets than you allocated. That is, if you allocated a group of contiguous pages or pagelets by a single call to LIB\$GET\_VM\_PAGE, you can deallocate them in several calls to LIB\$FREE\_VM\_PAGE. You can also combine contiguous groups of pages or pagelets that were allocated in several calls to LIB\$GET\_VM\_PAGE into one large group that is freed by a single call to LIB\$FREE\_VM\_PAGE.

LIB\$FREE\_VM\_PAGE is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_BADBLOADR | Pages on VAX systems or pagelets on Alpha systems not allocated by LIB\$GET_VM_PAGE, the value of <b>base-address</b> is not a page boundary, or the pages were previously freed. |
| LIB\$_BADBLOSIZ | The <b>number-of-pages</b> argument is less than or equal to zero.  |

---

## LIB\$FREE\_VM\_PAGE\_64 (Alpha Only)

### Free Virtual Memory Page

The Free Virtual Memory Page routine deallocates a block of contiguous Alpha pagelets that were allocated by previous calls to LIB\$GET\_VM\_PAGE\_64.

#### Format

LIB\$FREE\_VM\_PAGE\_64 number-of-pages ,base-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-pages

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Number of Alpha pagelets. The **number-of-pages** argument is the address of a quadword integer which specifies the number of contiguous Alpha pagelets to be deallocated. The value of **number-of-pages** must be greater than zero.

##### base-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Block address. The **base-address** argument is the address of a quadword which contains the address of the first byte of the first Alpha pagelet to be deallocated.

#### Description

LIB\$FREE\_VM\_PAGE\_64 deallocates a block of contiguous Alpha pagelets starting at **base-address**. Each of the pagelets specified by **number-of-pages** and **base-address** must have been allocated by previous calls to LIB\$GET\_VM\_PAGE\_64. The pagelets are returned to the processwide pool and are available to satisfy subsequent calls to LIB\$GET\_VM\_PAGE\_64.

You can free a smaller group of pagelets than you allocated. That is, if you allocated a group of contiguous pagelets by a single call to LIB\$GET\_VM\_PAGE\_64, you can deallocate them in several calls to LIB\$FREE\_VM\_PAGE\_64. You can also combine contiguous groups of pagelets that were allocated in several calls to LIB\$GET\_VM\_PAGE\_64 into one large group that is freed by a single call to LIB\$FREE\_VM\_PAGE\_64.

LIB\$FREE\_VM\_PAGE\_64 is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

**LIB\$ Routines**  
**LIB\$FREE\_VM\_PAGE\_64 (Alpha Only)**

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_BADBLOADR | Alpha pagelets not allocated by LIB\$GET_VM_PAGE_64, the value of <b>base-address</b> is not a pagelet boundary, or the pagelets were previously freed. |
| LIB\$_BADBLOSIZ | The <b>number-of-pages</b> argument is less than or equal to zero.  |

---

## LIB\$GETDVI

### Get Device/Volume Information

The Get Device/Volume Information routine provides a simplified interface to the \$GETDVI system service. It returns information about the primary and secondary device characteristics of an I/O device. The calling process need not have a channel assigned to the device about which it wants information.

#### Format

```
LIB$GETDVI item-code [,channel] [,device-name] [,longword-integer-value] [,resultant-string]
           [,resultant-length]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### item-code

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Code specifying the item of information you are requesting. The **item-code** argument is the address of a signed longword containing the item code. All valid \$GETDVI item codes whose names begin with DVI\$\_ are accepted.

See the Description section for more information on item codes.

##### channel

OpenVMS usage: channel  
type: word (unsigned)  
access: read only  
mechanism: by reference

OpenVMS I/O channel assigned to the device for which LIB\$GETDVI returns information. The **channel** argument is the address of an unsigned word containing the channel specification. If **channel** is not specified, **device-name** is used instead. You must specify either **channel** or **device-name**, but not both. If neither is specified, the error status SS\$\_IVDEVNAM is returned.

##### device-name

OpenVMS usage: device\_name  
type: character string  
access: read only  
mechanism: by descriptor

Name of the device for which LIB\$GETDVI returns information. The **device-name** argument is the address of a descriptor pointing to the device name string. If this string contains a colon, the colon and the characters that follow it are ignored.

## LIB\$ Routines

### LIB\$GETDVI

The **device-name** may be either a physical device name or a logical name. If the first character in the string is an underscore character (`_`), the name is considered a physical device name. Otherwise, the name is considered a logical name, and logical name translation is performed until either a physical device name is found or the system default number of translations has been performed.

If **device-name** is not specified, **channel** is used instead. You must specify either **channel** or **device-name**, but not both. If neither is specified, the error status `SS$_IVDEVNAM` is returned. The device name must not be longer than 255 characters.

#### longword-integer-value

OpenVMS usage: `longword_signed`  
type: `longword (signed)`  
access: `write only`  
mechanism: `by reference`

Numeric value of the information requested. The **longword-integer-value** argument is the address of a signed longword containing the numeric value. If an item is listed as only returning a string value, this argument is ignored.

#### resultant-string

OpenVMS usage: `char_string`  
type: `character string`  
access: `write only`  
mechanism: `by descriptor`

String representation of the information requested. The **resultant-string** argument is the address of a descriptor pointing to this information. If **resultant-string** is not specified and if the value returned has only a string representation, the error status `LIB$_INVARG` is returned.

Refer to Table LIB-4 for a description of the string representation used for each item.

#### resultant-length

OpenVMS usage: `word_unsigned`  
type: `word (unsigned)`  
access: `write only`  
mechanism: `by reference`

Number of significant characters written to **resultant-string** by `LIB$GETDVI`. The **resultant-length** argument is the address of an unsigned word containing this length.

## Description

`LIB$GETDVI` returns two categories of information:

- Primary device characteristics
- Secondary device characteristics

`LIB$GETDVI` does not allow you to get more than one item of information in a single call.

LIB\$GETDVI provides the following features in addition to those provided by the \$GETDVI system service.

- Instead of a list of item descriptors, which may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items which return numeric values, LIB\$GETDVI can optionally provide a formatted string interpretation of the value. For example, if the device owner UIC is requested, LIB\$GETDVI can return the UIC formatted as [identifier].
- For string arguments, LIB\$GETDVI understands all string classes supported by the Run-Time Library.
- Calls to LIB\$GETDVI are synchronous; LIB\$GETDVI calls LIB\$GET\_EF to allocate a local event flag number for synchronization.

See the description of the \$GETDVI system service in the *OpenVMS System Services Reference Manual* for more detailed information.

#### Item Codes

All item codes that can be used with the \$GETDVI system service may be used as the **item-code** argument to LIB\$GETDVI. These codes have symbolic names beginning with DVI\$\_.

The use of a DVI\$\_ code by itself will return the primary device characteristic associated with that code. To obtain the secondary device characteristics, add 1 to the code. See the description of the \$GETDVI system service for a list of the defined item codes. The symbolic names for these items are defined in Digital supplied symbol libraries in module \$DVIDEF (where appropriate).

#### Value Formats

By using the **longword-integer-value** and **resultant-string** arguments to LIB\$GETDVI, the information requested can be returned in two different fashions.

- For those items described as “string” in the table of Item Identifier Codes for the \$GETDVI service, the value is returned in **resultant-string**.
- For all other items—those that have numeric values—the numeric representation is returned in **longword-integer-value** (if specified), and a formatted string interpretation of the value is returned in **resultant-string**.

Each formatted item is written left-justified; **resultant-length**, if specified, gives the number of characters used. Table LIB-4 lists the formats used for the string interpretations.

**LIB\$ Routines**  
**LIB\$GETDVI**

**Table LIB-4 Formats Used for LIB\$GETDVI Strings**

| Item or Format | Description  |
|----------------|--|
| DVI\$_ACPPID   | The string value is returned as an 8-digit hexadecimal number.   |
| DVI\$_PID      | The string value is returned as an 8-digit hexadecimal number.   |
| DVI\$_ACPTYPE  | The ACP type string is one of the following:<br>NONE      No ACP<br>F11V1    Files-11 Level 1<br>F11V2    Files-11 Level 2<br>MTA      Magnetic Tape<br>NET      Networks<br>REM      Remote I/O   |
| DVI\$_OWNUIC   | The standard UIC format [group,member] is used. If the format of a UIC includes identifiers from the access rights database in place of the octal group and member numbers, the UIC string returned will have these identifiers, if available. |
| DVI\$_VPROT    | The volume protection string is in the following form:<br>SYSTEM=RWLP,OWNER=RWLP,GROUP=RWLP,WORLD=RWLP<br>If a category has no access, the equal sign is omitted. The string will not contain any embedded spaces.                             |
| Boolean        | The value string returned is TRUE if the low bit of the value is set, or FALSE if the low bit is clear.  |
| All others     | The value string is returned in the form of an unsigned decimal integer.   |

**Condition Values Returned**

|               |   |
|---------------|---|
| SS\$_NORMAL   | Normal successful completion.   |
| LIB\$_STRTRU  | String truncated. This is an alternate success return status. The <b>resultant-string</b> argument could not contain all the characters of the returned item. |
| SS\$_BADPARAM | Unrecognized item code. The <b>item-code</b> argument was not recognized as valid by \$GETSYI.  |
| SS\$_IVDEVNAM | The device name string contains invalid characters, or neither the <b>channel</b> nor <b>device-name</b> arguments were specified.                            |
| LIB\$_INSEF   | Insufficient event flags. A local event flag number could not be allocated by a call to LIB\$GET_EF.  |

|                 |   |
|-----------------|---|
| LIB\$_INVARG    | Invalid arguments. The \$GETSYI Item Identifier code describes the item as "string", and no <b>resultant-string</b> argument was specified. |
| LIB\$_INVSTRDES | Invalid string descriptor. The descriptor of the <b>resultant-string</b> argument is not a valid descriptor.                                |
| LIB\$_WRONUMARG | Wrong number of arguments. An incorrect number of arguments was passed to LIB\$GETDVI.  |

Any condition values returned by LIB\$COPY\_xxx.

Any condition values returned by SYS\$GETDVI.

---

## LIB\$GETJPI

### Get Job/Process Information

The Get Job/Process Information routine provides a simplified interface to the \$GETJPI system service. It provides accounting, status, and identification information about a specified process.

LIB\$GETJPI obtains only one item of information in a single call.

#### Format

```
LIB$GETJPI item-code [,process-id] [,process-name] [,resultant-value] [,resultant-string]
           [,resultant-length]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### item-code

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Item identifier code specifying the item of information you are requesting. The **item-code** argument is the address of a signed longword containing the item code. You may request only one item in each call to LIB\$GETJPI.

LIB\$GETJPI accepts all \$GETJPI item codes. These names begin with JPI\$\_ and are defined in Digital supplied symbol libraries in module \$JPIDEF.

##### process-id

OpenVMS usage: process\_id  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Process identifier of the process for which you are requesting information. The **process-id** argument is the address of an unsigned longword containing the process identifier. If you do not specify **process-id**, **process-name** is used.

The **process-id** is updated to contain the process identifier actually used, which may be different from what you originally requested if you specified **process-name** or used wildcard process searching.

**process-name**

OpenVMS usage: process\_name  
type: character string  
access: read only  
mechanism: by descriptor

A 1- to 15-character string specifying the name of the process for which you are requesting information. The **process-name** argument is the address of a descriptor pointing to the process name string. The name must correspond exactly to the name of the process for which you are requesting information; LIB\$GETJPI does not allow trailing blanks or abbreviations.

If you do not specify **process-name**, **process-id** is used. If you specify neither **process-name** nor **process-id**, the caller's process is used. Also, if you do not specify **process-name** and you specify zero for **process-id**, the caller's process is used. In this way, you can fetch the item you want and the caller's PID in a single call to LIB\$GETJPI.

**resultant-value**

OpenVMS usage: varying\_arg  
type: unspecified  
access: write only  
mechanism: by reference

Numeric value of the information you request. The **resultant-value** argument is the address of a longword or quadword into which LIB\$GETJPI writes the numeric value of this information. Refer to Table LIB-5 for information on which items return longword values and which return quadword values. If the item you request returns only a string value, this argument is ignored.

**resultant-string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String representation of the information you request. The **resultant-string** argument is the address of a character string into which LIB\$GETJPI writes the string representation. Table LIB-5 describes the string representation used for each item.

If you do not include **resultant-string**, but the item you request has only a string representation, the error status LIB\$\_INVARG is returned.

**resultant-length**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of significant characters written to **resultant-string** by LIB\$GETJPI. The **resultant-length** argument is the address of an unsigned word integer into which LIB\$GETJPI writes the number of characters.

## LIB\$ Routines LIB\$GETJPI

### Description

LIB\$GETJPI provides the following features in addition to those provided by the \$GETJPI system service:

- Instead of a list of item descriptors, which may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items which return numeric values, LIB\$GETJPI can optionally provide a formatted string interpretation of the value. For example, if the process UIC is requested, LIB\$GETJPI can return the UIC formatted as [g,m].
- For string arguments, all string classes supported by the Run-Time Library are understood.
- Calls to LIB\$GETJPI are synchronous. LIB\$GETJPI calls LIB\$GET\_EF to allocate a local event flag number for synchronization.

See the description of the \$GETJPI system service in the *OpenVMS System Services Reference Manual* for more information.

By using the **resultant-value** and **resultant-string** arguments to LIB\$GETJPI, you can request that the information be returned in two ways. For those items described as “string” in the table of Item Identifier Codes for the \$GETJPI service, the value is returned in **resultant-string**. For all other items—those which have numeric values—the numeric representation is returned in **resultant-value** (if specified), and a formatted string interpretation of the value is returned in **resultant-string**.

Each formatted item is written left-justified; **resultant-length**, if specified, gives the number of characters used.

Table LIB-5 lists the formats used for the string interpretations.

**Table LIB-5 Item Code Formats for LIB\$GETJPI**

| Item or Format | Description   |
|----------------|---|
| JPI\$_AUTHPRIV | The string representation of these quadword privilege masks is a list of each privilege that is enabled. The privilege names are in uppercase, and are separated by commas. |
| JPI\$_CURPRIV  | Same as for JPI\$AUTHPRIV.  |
| JPI\$_IMAGPRIV | Same as for JPI\$AUTHPRIV.  |
| JPI\$_PROCPRIV | Same as for JPI\$AUTHPRIV.  |
| JPI\$_LOGINTIM | The string representation of the quadword time is a standard absolute date-time string.   |
| JPI\$_PID      | The process identification string is an 8-digit hexadecimal number.   |

(continued on next page)

Table LIB-5 (Cont.) Item Code Formats for LIB\$GETJPI

| Item or Format | Description  |
|----------------|--|
| JPI\$_STATE    | The process state string is one of the following:<br>CEF Common event flag wait<br>COM Computable<br>COMO Computable, outswapped<br>CUR Current process<br>COLPG Collided page wait<br>FPG Free page wait<br>HIB Hibernate wait<br>HIBO Hibernate wait, outswapped<br>LEF Local event flag wait<br>LEFO Local event flag wait, outswapped<br>MWAIT Mutex and miscellaneous resource wait<br>PFW Page fault wait<br>SUSP Suspended<br>SUSPO Suspended, outswapped |
| JPI\$_UIC      | The standard UIC format [group,member] is used. If the format of a UIC includes identifiers from the access rights database in place of the octal group and member numbers, the UIC string returned will have these identifiers, if available.   |
| JPI\$_MODE     | The current mode string is one of the following: BATCH, INTERACTIVE or NETWORK.  |
| All others     | The string value is returned as an unsigned decimal integer.   |

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_STRTRU    | String truncated. This is an alternate success return status. The <b>resultant-string</b> argument could not contain all the characters of the returned item. |
| SS\$_BADPARAM   | Unrecognized item code. The <b>item-code</b> argument was not recognized as valid by \$GETJPI.  |
| LIB\$_INSEF     | Insufficient event flags. A local event flag number could not be allocated by a call to LIB\$GET_EF.  |
| LIB\$_INVARG    | Invalid arguments. The \$GETSYI Item Identifier code describes the item as "string", and no <b>resultant-string</b> argument was specified.                   |
| LIB\$_INVSTRDES | Invalid string descriptor. The descriptor for a string argument was not a valid string descriptor.  |

**LIB\$ Routines**  
**LIB\$GETJPI**

LIB\$\_WRONUMARG            Wrong number of arguments. An incorrect  
                                 number of arguments was passed to  
                                 LIB\$GETJPI.

Any condition value returned by LIB\$SCOPY\_xxx.

Any condition value returned by SYS\$GETJPI.

---

## LIB\$GETQUI

### Get Queue Information

The Get Queue Information routine provides a simplified interface to the \$GETQUI system service. It provides queue, job, file, characteristic, and form information about a specified process.

LIB\$GETQUI obtains only one item of information in a single call.

#### Format

```
LIB$GETQUI function-code [,item-code] [,search-number] [,search-name] [,search-flags] [,resultant-value]
           [,resultant-string] [,resultant-length]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### function-code

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Function code specifying the function that LIB\$GETQUI is to perform. The **function-code** argument is the address of a signed longword containing the function code.

LIB\$GETQUI accepts all \$GETQUI function codes. These names begin with QUI\$\_ and are defined in Digital supplied symbol libraries in module \$QUIDEF.

##### item-code

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Item identifier code specifying the item of information you are requesting. The **item-code** argument is the address of a signed longword containing the item code. You may request only one item in each call to LIB\$GETQUI.

LIB\$GETQUI accepts all \$GETQUI item codes. These names begin with QUI\$\_ and are defined in Digital supplied symbol libraries in module \$QUIDEF.

## LIB\$ Routines

### LIB\$GETQUI

#### **search-number**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Numeric value used to process your request. The **search-number** argument is the address of a signed longword integer containing the number needed to process your request. The **search-number** argument corresponds directly to QUI\$\_SEARCH\_NUMBER as described by the \$GETQUI system service.

#### **search-name**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Character string used to process your request. The **search-name** argument is the address of a string descriptor that provides the name needed to process your request. The **search-name** argument corresponds directly to QUI\$\_SEARCH\_NAME as described by the \$GETQUI system service.

#### **search-flags**

OpenVMS usage: longword\_unsigned  
type: longword integer (unsigned)  
access: read only  
mechanism: by reference

Optional bit mask indicating request to be performed. The **search-flags** argument is the address of an unsigned longword integer containing the bit mask. The **search-flags** argument directly corresponds to \$QUI\$\_SEARCH\_FLAGS as described by the \$GETQUI system service.

#### **resultant-value**

OpenVMS usage: varying\_arg  
type: unspecified  
access: write only  
mechanism: by reference

Numeric value of the information you requested. The **resultant-value** argument is the address of a longword, quadword or octaword into which LIB\$GETQUI writes the numeric value of this information. Refer to Table LIB-6 for information on which items return values other than longwords.

If the item you requested returns only a string value, this argument is ignored.

#### **resultant-string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String representation of the information you requested. The **resultant-string** argument is the address of a character string into which LIB\$GETQUI writes the string representation. Table LIB-6 describes the string representation used for each item.

If you do not include **resultant-string**, but the item you request has only a string representation, the error status LIB\$\_INVARG is returned.

**resultant-length**

OpenVMS usage: word\_signed  
type: word integer (signed)  
access: write only  
mechanism: by reference

Number of significant characters written to **resultant-string** by LIB\$GETQUI. The **resultant-length** argument is the address of a signed word integer into which LIB\$GETQUI writes the number of characters.

## Description

LIB\$GETQUI provides a simplified interface to the \$GETQUI system service. It provides queue, job, file, characteristic, and form information about a specified process. This routine obtains only one item of information in a single call.

LIB\$GETQUI provides the following features in addition to those provided by the \$GETQUI system service.

- Instead of a list of item descriptors that may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items that return numeric values, LIB\$GETQUI optionally can provide a formatted string interpretation of the value. For example, if you request the characteristics of a queue, LIB\$GETQUI can return the list of characteristics as "23,42,76,98,125".
- For string arguments, all string classes supported by the Run-Time Library are understood.
- Calls to LIB\$GETQUI are synchronous. LIB\$GETQUI calls \$GETQUIW to force the synchronization.

LIB\$GETQUI retains context. This means that previous calls to LIB\$GETQUI affect current calls to LIB\$GETQUI.

See the description of the \$GETQUI system service in the *OpenVMS System Services Reference Manual* for more information.

By using the **resultant-value** and **resultant-string** arguments to LIB\$GETQUI, you can request that the information be returned in two ways. For items that have numeric values, the numeric representation is returned in **resultant-value** (if specified), and a formatted string interpretation of the value is returned in **resultant-string**. For those items described as "string" in the table of Item Identifier Codes for the \$GETQUI service, the value is returned in **resultant-string**.

Each formatted item is written left-justified; **resultant-length**, if specified, gives the number of characters used.

The \$GETQUI system service requires some item codes. LIB\$GETQUI provides those item codes for you by corresponding your input to LIB\$GETQUI directly to the required input codes.

## LIB\$ Routines

### LIB\$GETQUI

The following table describes all of the required and optional input needed to perform your task with LIB\$GETQUI:

| Function                     | Input Description  |
|------------------------------|--|
| QUI\$_CANCEL                 | Accepts no input.  |
| QUI\$_DISPLAY_CHARACTERISTIC | A characteristic name or number, or both. Optionally, a search flags number.   |
| QUI\$_DISPLAY_ENTRY          | Optionally, an entry number, user name, and search flags number. The default user name is that of the calling process. |
| QUI\$_DISPLAY_FILE           | Optionally, a search flags number.   |
| QUI\$_DISPLAY_FORM           | A form name or number, or both. Optionally, a search flags number.   |
| QUI\$_DISPLAY_JOB            | Optionally, a search flags number.   |
| QUI\$_DISPLAY_QUEUE          | A queue name. Optionally, a search flags number.   |
| QUI\$_TRANSLATE_QUEUE        | A queue name.  |

Table LIB-6 lists the formats used for the string interpretations.

**Table LIB-6 Item Code Formats for LIB\$GETQUI**

| Item or Format        | Description   |
|-----------------------|---|
| QUI\$_AFTER_TIME      | Returns a quadword <b>resultant-value</b> as well as a <b>resultant-string</b> .  |
| QUI\$_CHARACTERISTICS | Returns an octaword <b>resultant-value</b> as well as a comma-separated list that lists all the characteristic numbers, output as a <b>resultant-string</b> . |
| QUI\$_SUBMISSION_TIME | Returns a quadword <b>resultant-value</b> as well as a <b>resultant-string</b> .  |
| QUI\$_UIC             | Returns a formatted <b>resultant-string</b> as well as a longword.  |

### Condition Values Returned

|               |   |
|---------------|---|
| SS\$_NORMAL   | Routine successfully completed.   |
| LIB\$_STRTRU  | String truncated. This is an alternate success return status. The <b>resultant-string</b> argument could not contain all the characters of the returned item. |
| SS\$_BADPARAM | Unrecognized item code. The <b>item-code</b> argument was not recognized as valid by \$GETQUI.  |

|                 |   |
|-----------------|---|
| LIB\$_INSEF     | Insufficient event flags. A local event flag number could not be allocated by a call to LIB\$GET_EF.  |
| LIB\$_INVARG    | Invalid arguments. The \$GETSYI Item Identifier code describes the item as "string", and no <b>resultant-string</b> argument was specified. |
| LIB\$_INVSTRDES | Invalid string descriptor. The descriptor for a string argument was not a valid string descriptor.  |
| LIB\$_WRONUMARG | Wrong number of arguments. An incorrect number of arguments was passed to LIB\$GETQUI.  |

Any condition value returned by LIB\$SCOPY\_xxx.

Any condition value returned by SYS\$GETQUI.

---

## LIB\$GETSYI

### Get Systemwide Information

The Get Systemwide Information routine provides a simplified interface to the \$GETSYI system service. The \$GETSYI system service obtains status and identification information about the system. LIB\$GETSYI returns only one item of information in a single call.

#### Format

```
LIB$GETSYI item-code [,resultant-value] [,resultant-string] [,resultant-length] [,cluster-system-id]
           [,node-name]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### item-code

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Item code specifying the desired item of information. The **item-code** argument is the address of a signed longword containing this item code. All valid \$GETSYI item codes are accepted.

##### resultant-value

OpenVMS usage: varying\_arg  
type: unspecified  
access: write only  
mechanism: by reference

Numeric value returned by LIB\$GETSYI. The **resultant-value** argument is the address of a longword or quadword containing this value. If an item is listed as returning only a string value, this argument is ignored.

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Information returned by LIB\$GETSYI. The **resultant-string** argument is the address of a descriptor pointing to the character string that will receive this information.

See the Description section for more information about value formats. If **resultant-string** is not specified and if the returned value has only a string representation, the error status LIB\$\_INVARG is returned.

**resultant-length**

OpenVMS usage: word\_unsigned  
 type: word (unsigned)  
 access: write only  
 mechanism: by reference

Number of significant characters written to **resultant-string**, not including blank padding or truncated characters. The **resultant-length** argument is the address of an unsigned word into which LIB\$GETSYI returns this number.

**cluster-system-id**

OpenVMS usage: identifier  
 type: longword (unsigned)  
 access: modify  
 mechanism: by reference

Cluster system identification (CSID) of the node for which information is to be returned. The **cluster-system-id** argument is the address of this CSID. If **cluster-system-id** is specified and is nonzero, **node-name** is not used. If **cluster-system-id** is specified as zero, LIB\$GETSYI uses **node-name** and writes into the **cluster-system-id** argument the CSID corresponding to the node identified by **node-name**.

The **cluster-system-id** of an OpenVMS node is assigned by the cluster-connection software and may be obtained by the DCL command SHOW CLUSTER. The value of the **cluster-system-id** for an OpenVMS node is not permanent; a new value is assigned to an OpenVMS node whenever it joins or rejoins the VAXcluster.

If **cluster-system-id** is specified as -1, LIB\$GETSYI assumes a wildcard operation and returns the requested information for each OpenVMS node in the cluster, one node per call.

If **cluster-system-id** is not specified, **node-name** is used.

**node-name**

OpenVMS usage: char\_string  
 type: character string  
 access: read only  
 mechanism: by descriptor

Name of the node for which information is to be returned. The **node-name** argument is the address of a descriptor pointing to the node name string. If **cluster-system-id** is not specified or is specified as zero, **node-name** is used. If neither **node-name** nor **cluster-system-id** is specified, the caller's node is used. See the **cluster-system-id** argument for more information.

The node name string must contain from 1 to 15 characters and must correspond exactly to the OpenVMS node name; no trailing blanks nor abbreviations are permitted.

## LIB\$ Routines

### LIB\$GETSYI

#### Description

LIB\$GETSYI provides the following features in addition to those provided by the \$GETSYI system service:

- Instead of a list of item descriptors, which may be difficult to construct in high-level languages, the single item desired is specified as an integer code which is passed by reference. Results are written to separate arguments.
- For items which return numeric values, LIB\$GETSYI can optionally provide a formatted string interpretation of the value.
- For string arguments, all string classes supported by the Run-Time Library are understood.
- Calls to LIB\$GETSYI are synchronous. LIB\$GETSYI calls LIB\$GET\_EF to allocate a local event flag number for synchronization.

All item codes that can be used with the \$GETSYI system service may be used as the **item-code** argument to LIB\$GETSYI. See the description of the \$GETSYI system service for a list of the defined item codes. Note that the symbolic names for these items are defined in Digital supplied symbol libraries in module \$SYIDEF (where appropriate).

#### Value Formats

By using the **resultant-value** and **resultant-string** arguments to LIB\$GETSYI, you can request that the information be returned in two ways. For those items described as “string” in the table of Item Identifier Codes for the \$GETSYI service, the value is returned in **resultant-string**. For all other items—those which have numeric values—the numeric representation is returned in **resultant-value** (if specified), and an unsigned decimal integer representation is stored in **resultant-string**.

Each formatted item is written left-justified; **resultant-length**, if specified, gives the number of characters used.

See the *OpenVMS System Services Reference Manual* for a description of the \$GETSYI system service.

#### Condition Values Returned

|               |   |
|---------------|---|
| SS\$_NORMAL   | Routine successfully completed.   |
| LIB\$_STRTRU  | String truncated. This is an alternate success return status. The <b>resultant-string</b> argument could not contain all the characters of the returned item. |
| SS\$_BADPARAM | Unrecognized item code. The <b>item-code</b> argument was not recognized as valid by \$GETSYI.  |
| LIB\$_INSEF   | Insufficient event flags. A local event flag number could not be allocated by a call to LIB\$GET_EF.  |
| LIB\$_INVARG  | Invalid arguments. The \$GETSYI item identifier code describes the item as “string”, and no <b>resultant-string</b> argument was specified.                   |

|                 |  |
|-----------------|--|
| LIB\$_INVSTRDES | Invalid string descriptor. The descriptor of the <b>resultant-string</b> argument is not a valid descriptor. |
| LIB\$_WRONUMARG | Wrong number of arguments. An incorrect number of arguments was passed to LIB\$GETSYI.                       |

Any condition values returned by LIB\$COPY\_xxx.

Any condition values returned by the \$GETSYI system service.

## LIB\$ Routines

### LIB\$GET\_ACCNAM (VAX Only)

---

## LIB\$GET\_ACCNAM (VAX Only)

### Get Access Name Table for Protected Object Class (by Name)

The Get Access Name Table for Protected Object Class (by Name) routine returns a pointer to the access name table for a protected object class that is specified by name.

#### Format

LIB\$GET\_ACCNAM [clsnam] , [objnam] ,accnam

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### clsnam

OpenVMS usage: char\_string  
type: character-coded text string  
access: read only  
mechanism: by descriptor

The **clsnam** argument is the address of a character string descriptor pointing to the name of a security object class. This argument is optional and defaults to FILE.

##### objnam

OpenVMS usage: char\_string  
type: character-coded text string  
access: read only  
mechanism: by descriptor

The **objnam** argument is the address of a character-string descriptor pointing to the name of a protected object. This argument is optional. If it is omitted, the access name table returned is that used for objects of the class specified by the **clsnam** argument.

##### accnam

OpenVMS usage: access\_names  
type: longword (unsigned)  
access: write only  
mechanism: by reference

The **accnam** argument is the address of a longword into which this routine writes the address of the access name table.

## Description

LIB\$GET\_ACCNAM returns the address of the access name table for the specified protected object. The format of the table is a vector of 32 quadword string descriptors. Each table entry points to the name of an access type. The index into the vector is the bit position in an access-desired mask. Undefined access types have zero-length names. The table can be used as input to the LIB\$PARSE\_SOGW\_PROT, LIB\$FORMAT\_SOGW\_PROT, LIB\$PARSE\_ACCESS\_CODE, \$PARSE\_ACL, and \$FORMAT\_ACL routines.

The semantics of this routine are as follows:

1. If the **clsnam** parameter is omitted, it defaults to "FILE."
2. If **clsnam** is not the name of an object class, then the routine returns an error status (SS\$\_NOCLASS), and the value of **accnam** is undefined.
3. If the **objnam** parameter is omitted, then **accnam** points to the table corresponding to **clsnam**, and the routine returns a success status (SS\$\_NORMAL). The table returned is the table of access names for a new object of class **clsnam**.
4. Otherwise, if **clsnam** and **objnam** do in fact name a protected object, then **accnam** points to the table corresponding to the protected object class, and the routine returns a success status (SS\$\_NORMAL).
5. Otherwise, if **clsnam** and **objnam** do *not* name a protected object, then the routine returns an error status (the exact status value depends on the security class), and the value of **accnam** is undefined.

## Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.         |
| SS\$_NOCLASS    | No matching object class was found.     |
| LIB\$_WRONUMARG | Wrong number of arguments.              |
| LIB\$_INVARG    | The <b>accnam</b> argument was omitted. |

In addition, any completion status may be returned from \$GET\_SECURITY.

## LIB\$GET\_ACCNAM\_BY\_CONTEXT (VAX Only) Get Access Name Table for Protected Object Class (by Context)

The Get Access Name Table for Protected Object Class (by Context) routine returns a pointer to the access name table for a protected object class that is specified by a context longword returned from \$GET\_SECURITY or \$SET\_SECURITY.

### Format

LIB\$GET\_ACCNAM\_BY\_CONTEXT *contxt* ,*accnam*

### Returns

OpenVMS usage: *cond\_value*  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

**contxt**  
OpenVMS usage: *context*  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The **contxt** argument is the address of a nonzero longword context value returned by \$GET\_SECURITY or \$SET\_SECURITY.

**accnam**  
OpenVMS usage: *access\_names*  
type: longword (unsigned)  
access: write only  
mechanism: by reference

The **accnam** argument is the address of a longword into which this routine writes the address of the access name table.

### Description

LIB\$GET\_ACCNAM\_BY\_CONTEXT returns the address of the access name table for the specified protected object class. The format of the table is a vector of 32 quadword string descriptors. Each table entry points to the name of an access type. The index into the vector is the bit position in an access-desired mask. Undefined access types have zero-length names. The table can be used as input to the LIB\$PARSE\_SOGW\_PROT, LIB\$FORMAT\_SOGW\_PROT, LIB\$PARSE\_ACCESS\_CODE, \$PARSE\_ACL, and \$FORMAT\_ACL routines.

## LIB\$ Routines LIB\$GET\_ACCNAM\_BY\_CONTEXT (VAX Only)

The semantics of this routine are as follows:

- If the **ctxt** argument is valid, then the **accnam** argument points to the table corresponding to the protected object class, and the routine returns a success status (SS\$\_NORMAL).
- If the **ctxt** argument is not valid, then the routine returns an error status, and the value of **accnam** is undefined.

### Condition Values Returned

SS\$\_NORMAL                      Routine successfully completed.

LIB\$\_WRONUMARG                Wrong number of arguments.

In addition, error status may be returned from \$GET\_SECURITY.

## LIB\$GET\_COMMAND

### Get Line from SYS\$COMMAND

The Get Line from SYS\$COMMAND routine gets one record of ASCII text from the current controlling input device, specified by the logical name SYS\$COMMAND.

#### Format

LIB\$GET\_COMMAND resultant-string [,prompt-string] [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String that LIB\$GET\_COMMAND gets from SYS\$COMMAND. The **resultant-string** argument is the address of a descriptor pointing to this string.

##### prompt-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Prompt message that LIB\$GET\_COMMAND displays on the controlling terminal. The **prompt-string** argument is the address of a descriptor pointing to the prompt. Any string can be a valid prompt. By convention however, a prompt string consists of text followed by a colon (:), a space, and no carriage-return/line-feed combination. The maximum size of the prompt message is 255 characters. If the controlling input device is not a terminal, this argument is ignored.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of bytes written into **resultant-string** by LIB\$GET\_COMMAND, not counting padding in the case of a fixed string. The **resultant-length** argument is the address of an unsigned word containing this length. If the input string is truncated to the size specified in the **resultant-string** descriptor, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **resultant-string**.

## Description

LIB\$GET\_COMMAND uses the RMS \$GET service (see the *OpenVMS Record Management Services Reference Manual*) to get one record of ASCII text from the current controlling input device, specified by SYS\$COMMAND.

When you log in, the OpenVMS operating system creates three files as default I/O control streams for your process.

- SYS\$INPUT, your default input device
- SYS\$OUTPUT, your default output device
- SYS\$COMMAND, the device that supplies the commands to your process

These files remain open until you log out. They are the interface between your interactive input and output or your batch commands and the OpenVMS software. Initially, all three files are equated with the terminal. However, with the DCL command ASSIGN, you can change these assignments to obtain information from a file or put information into a file. SYS\$INPUT and SYS\$COMMAND are usually identical, but the input and command streams can be different. For example, during the execution of an indirect command file from an interactive terminal, SYS\$COMMAND refers to the terminal and SYS\$INPUT refers to the command file.

LIB\$GET\_COMMAND opens file SYS\$COMMAND on the first call. The RMS internal stream identifier (ISI) is stored in the routine's static storage for subsequent calls.

If **prompt-string** is provided and if the SYS\$COMMAND device is a terminal, LIB\$GET\_COMMAND displays the prompt message. If the device is not a terminal, the **prompt-string** is ignored.

LIB\$GET\_COMMAND is used when a program needs input from some source other than the current input stream. Usually, it is used to input from the terminal rather than from an indirect command file. For example, a program may ask a question which cannot be answered by an indirect command file entry. In this case the program would call LIB\$GET\_COMMAND to get one record of ASCII text from SYS\$COMMAND, the terminal.

## Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed. RMS completion status.  |
| LIB\$_FATERRLIB | An internal consistency check on Run-Time Library data structures has failed. This may indicate a programming error in the Run-Time Library, or that your program may have overwritten those data structures.   |
| LIB\$_INPSTRTRU | The input string has been truncated to the size specified in the <b>resultant-string</b> descriptor (fixed-length strings only). The <b>resultant-length</b> argument is also set to this size. This is an error (as opposed to LIB\$_STRTRU which is a success) because the truncation is not under program control. |

**LIB\$ Routines**  
**LIB\$GET\_COMMAND**

|                 |  |
|-----------------|--|
| LIB\$_INSVIRMEM | Insufficient virtual memory to allocate the dynamic string.                        |
| LIB\$_INVARG    | Invalid arguments. The descriptor class field is not a recognized code or is zero. |

Any valid RMS status code.

Any code returned by LIB\$GET\_VM, LIB\$GET\_VM\_64, LIB\$SCOPY\_R\_DX, or LIB\$SCOPY\_R\_DX\_64.

---

## LIB\$GET\_COMMON

### Get String from Common

The Get String from Common routine copies a string in the common area to the destination string. (The common area is an area of storage which remains defined across multiple image activations in a process.) The string length is taken from the first longword of the common area.

#### Format

LIB\$GET\_COMMON resultant-string [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string into which LIB\$GET\_COMMON writes the string copied from the common area. The **resultant-string** argument is the address of a descriptor pointing to the destination string.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of characters written into **resultant-string** by LIB\$GET\_COMMON, not counting padding in the case of a fixed-length string. The **resultant-length** argument is the address of an unsigned word integer containing the number of characters copied. If the input string is truncated to the size specified in the **resultant-string** descriptor, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **resultant-string**.

#### Description

LIB\$PUT\_COMMON allows a program to copy a string into the process's common storage area. This area remains defined during multiple image activations. LIB\$GET\_COMMON allows a program to copy a string from the common area into a destination string. The programs reading and writing the data in the common area must agree upon its amount and format.

The maximum number of characters that can be copied is 252. The actual number of characters copied is returned by the optional argument, **resultant-length** (if given).

## LIB\$ Routines

### LIB\$GET\_COMMON

You can use LIB\$PUT\_COMMON and LIB\$GET\_COMMON to pass information between images run successively, such as chained images run by LIB\$RUN\_PROGRAM. Since the common area is unique to each process, do not use LIB\$GET\_COMMON and LIB\$PUT\_COMMON to share information across processes.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_STRTRU    | Successfully completed. The string was longer than the buffer and was truncated.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital. |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.  |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.   |

## LIB\$GET\_CURR\_INVO\_CONTEXT (Alpha Only) Get Current Invocation Context

The Get Current Invocation Context routine gets the current invocation context of any active procedure.

A thread can obtain the invocation context of a current procedure using the following function format:

### Format

```
LIB$GET_CURR_INVO_CONTEXT  invo_context
```

### Returns

None.

### Argument

#### **invo\_context**

OpenVMS usage: `invo_context_blk`

type: `structure`

access: `write only`

mechanism: `by reference`

Address of an invocation context block into which the procedure context of the caller will be written.

### Description

LIB\$GET\_CURR\_INVO\_CONTEXT gets the current invocation context of any active procedure.

See the *OpenVMS Calling Standard* manual for additional information.

### Condition Values Returned

None.

## LIB\$GET\_DATE\_FORMAT

### Get the User's Date Input Format

The Get The User's Date Input Format routine returns information about the user's choice of a date/time input format.

#### Format

LIB\$GET\_DATE\_FORMAT *format-string* [,*user-context*]

#### Returns

OpenVMS usage: *cond\_value*  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **format-string**

OpenVMS usage: *char\_string*  
type: character string  
access: write only  
mechanism: by descriptor

Receives the translation of LIB\$DT\_INPUT\_FORMAT. The **format-string** argument is the address of a descriptor pointing to this format string.

##### **user-context**

OpenVMS usage: *context*  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context variable that retains the translation context over multiple calls to this routine. The **user-context** argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

The **user-context** argument is optional. However, if a context cell is not passed, the routine LIB\$GET\_DATE\_FORMAT may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, Digital recommends that users specify a different context cell for each calling thread.

#### Description

Depending on which method was used to specify the input formats, LIB\$GET\_DATE\_FORMAT either translates the logicals LIB\$DT\_INPUT\_FORMAT and LIB\$FORMAT\_MNEMONICS, or uses the preinitialized context components LIB\$K\_FORMAT\_MNEMONICS and LIB\$K\_INPUT\_FORMAT to return the user's specified date/time input format in a "legible" form. This format string can then be used as a guideline for entering date/time strings.

## LIB\$ Routines LIB\$GET\_DATE\_FORMAT

The string returned by LIB\$GET\_DATE\_FORMAT parallels the currently defined input format string, consisting of the format punctuation (with most whitespace compressed) and “legible” mnemonics representing the various format fields. The English (default) versions of these mnemonics are as follows:

| Format Field           | Legible Mnemonic (Default) |
|------------------------|----------------------------|
| Year                   | YYYY <sup>1</sup>          |
| Numeric month          | MM                         |
| Alphabetic month       | MONTH                      |
| Numeric day            | DD                         |
| Hours (12- or 24-hour) | HH                         |
| Minutes                | MM                         |
| Seconds                | SS                         |
| Fractional seconds     | CC <sup>1</sup>            |
| Meridiem indicator     | AM/PM                      |

<sup>1</sup>This variable-length field mnemonic has a numeric suffix representing the number of digits allowed or required in the field. For instance, YYYY4 indicates a four-digit year field.

For example, consider the following input format string:

```
$ DEFINE LIB$DT INPUT FORMAT -
_ $ "!MAAU !D0, TY2 !H02:!M0:!S0.!C4 !MIU"
```

If LIB\$GET\_DATE\_FORMAT were called for this format string, the format string returned would be as follows:

```
MONTH DD, YYYY2 HH:MM:SS.CC4 AM/PM
```

See the *OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

### Condition Values Returned

|                  |  |
|------------------|--|
| SS\$_NORMAL      | Routine successfully completed.                            |
| LIB\$_DEFFORUSE  | Default format used; unable to determine desired format.   |
| LIB\$_ENGLUSED   | English used; unable to determine or use desired language. |
| LIB\$_ILLFORMAT  | Illegal format string.                                     |
| LIB\$_INVARG     | Invalid argument; a required argument was not specified.   |
| LIB\$_INVSTRDES  | Invalid input string descriptor.                           |
| LIB\$_REENTRANCY | Reentrancy detected.                                       |
| LIB\$_STRTRU     | String truncated.  |
| LIB\$_UNRFORCOD  | Unrecognized format code.                                  |
| LIB\$_WRONUMARG  | Wrong number of arguments.                                 |

Any condition value returned by LIB\$GET\_VM, LIB\$SCOPY\_R\_DX, and LIB\$SFREE1\_DD.

---

## LIB\$GET\_EF

### Get Event Flag

The Get Event Flag routine allocates one local event flag from a processwide pool and returns the number of the allocated flag to the caller. If no flags are available, LIB\$GET\_EF returns an error as its function value.

#### Format

LIB\$GET\_EF event-flag-number

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**event-flag-number**  
OpenVMS usage: ef\_number  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Number of the local event flag that LIB\$GET\_EF allocated, or -1 if no local event flag was available. The **event-flag-number** argument is the address of a signed longword integer into which LIB\$GET\_EF writes the number of the local event flag that it allocates.

#### Description

LIB\$GET\_EF and LIB\$FREE\_EF cause local event flags to be allocated and deallocated at run time, so that your routine remains independent of other routines executing in the same process.

The following table lists status of local event flags.

| Number        | Status  |
|---------------|---|
| 0             | Never used by this routine and always available                 |
| 1 through 23  | Initially reserved; available after being freed by LIB\$FREE_EF |
| 24 through 31 | Reserved to OpenVMS   |
| 32 through 63 | Initially free  |

Local event flags numbered 32 through 63 are available to your program. These event flags allow routines to communicate and synchronize their operations.

Using LIB\$GET\_EF provides your program with an arbitrary event flag number. You can obtain a specific event flag number by calling LIB\$RESERVE\_EF and passing as an argument the number of the specific event flag that you want to reserve. However, reserving a specific local event flag number is not recommended. If you use a specific event flag in your routine, another routine may attempt to use the same flag, and the flag will no longer function as

expected. Therefore, you should call LIB\$GET\_EF to obtain the next arbitrary event flag and LIB\$FREE\_EF to return it to the storage pool.

**Condition Values Returned**

SS\$NORMAL

Routine successfully completed.

LIB\$INSEF

Insufficient event flags. There were no more event flags available for allocation.

## LIB\$GET\_FOREIGN

### Get Foreign Command Line

The Get Foreign Command Line routine requests the calling image's command language interpreter (CLI) to return the contents of the "foreign command" line that activated the current image.

#### Format

LIB\$GET\_FOREIGN resultant-string [,prompt-string] [,resultant-length] [,flags]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String which LIB\$GET\_FOREIGN uses to receive the foreign command line. The **resultant-string** argument is the address of a descriptor pointing to this string. If the foreign command text returned was obtained by prompting to SYS\$INPUT (see the description of **flags**), the text is translated to uppercase so as to be more consistent with text returned from the CLI.

##### prompt-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Optional user-supplied prompt for text which LIB\$GET\_FOREIGN uses if no command-line text is available. The **prompt-string** argument is the address of a descriptor pointing to the user prompt. If omitted, no prompting is performed. It is recommended that **prompt-string** be specified. If **prompt-string** is omitted and if no command-line text is available, a zero-length string will be returned.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of bytes written into **resultant-string** by LIB\$GET\_FOREIGN, not counting padding in the case of a fixed-length **resultant-string**. The **resultant-length** argument is the address of an unsigned word into which LIB\$GET\_FOREIGN writes the number of bytes.

**flags**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: modify  
 mechanism: by reference

Value which LIB\$GET\_FOREIGN uses to control whether or not prompting is to be performed. The **flags** argument is the address of an unsigned longword integer containing this value. If the low bit of **flags** is zero, or if **flags** is omitted, prompting is done only if the CLI does not return a command line. If the low bit is 1, prompting is done unconditionally. If specified, **flags** is set to 1 before returning to the caller.

The primary use of **flags** is to allow a utility program to be invoked once with subcommand text on the command line, and then to repeatedly prompt for further subcommands from SYS\$INPUT. This is accomplished by calling LIB\$GET\_FOREIGN repeatedly, specifying in the call a **prompt-string** string and a **flags** variable which is initialized to zero at the beginning of the program. The first call gets the subcommand text from the command line, after which **flags** will be set to 1, causing further subcommands to be requested through prompts to SYS\$INPUT.

**Description**

LIB\$GET\_FOREIGN returns the contents of the command line that you use to activate an image. It can be used to give your program access to the qualifiers of a foreign command or to prompt for further command line text.

A foreign command is a command that you can define and then use as if it were a DCL or MCR command in order to run a program. When you use the foreign command at command level, the CLI parses the foreign command only and activates the image. It ignores any options or qualifiers that you have defined for the foreign command. Once the CLI has activated the image, the program can call LIB\$GET\_FOREIGN to obtain and parse the remainder of the command line (after the command itself) for whatever options it may contain. See the *OpenVMS User's Manual* for information on how to define a foreign command.

If no command line is available, LIB\$GET\_FOREIGN can optionally call LIB\$GET\_INPUT to prompt the user for command text. If desired, LIB\$GET\_FOREIGN can be called repetitively, returning the command line on the first call, but prompting for further text on subsequent calls.

LIB\$GET\_FOREIGN can also be used for images invoked by the RUN command, for which further text must be obtained by prompting. Such an image can also be invoked by the DCL command MCR or by the MCR Command Language Interpreter. The text following the image name will be returned to the executing image.

The action of LIB\$GET\_FOREIGN depends on the environment in which the image is activated.

- If you use a foreign command to invoke the image, you can call LIB\$GET\_FOREIGN to obtain the command qualifiers following the foreign command. You can also use LIB\$GET\_FOREIGN to prompt repeatedly for more qualifiers after the command. This technique is shown in the example.

## LIB\$ Routines

### LIB\$GET\_FOREIGN

- If the image is in the SYS\$SYSTEM: directory, the image can be invoked by the DCL command MCR or by the MCR command language interpreter (CLI). In this case, LIB\$GET\_FOREIGN returns the command line text following the image name.
- If the image is invoked by a DCL command RUN, LIB\$GET\_FOREIGN can be used to prompt for additional text.
- If the image is not invoked by a foreign command or MCR, or if there is no information remaining on the command line, and the user-supplied prompt is present, LIB\$GET\_INPUT is called to prompt for a command line. If the prompt is not present, LIB\$GET\_FOREIGN returns a zero length string.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_FATERRLIB | A fatal internal error was detected.  |
| LIB\$_INPSTRTRU | The input string was truncated. The <b>resultant-string</b> argument could not contain all of the characters. The <b>resultant-length</b> argument reflects the truncated length. |
| LIB\$_INSVIRMEM | Insufficient virtual memory.  |
| LIB\$_INVSTRDES | Invalid string descriptor.  |

A condition value returned by RMS. SYS\$INPUT was prompted for command text and RMS returned an error. The most typical error will be RMS\$\_EOF, end-of-file.

### Example

```
EXAMPLE: ROUTINE OPTIONS (MAIN);
%INCLUDE $STSDEF; /* Status-testing definitions */
DECLARE COMMAND LINE CHARACTER(80) VARYING,
        PROMPT_FLAG FIXED BINARY(31) INIT(0),
        LIB$GET_FOREIGN ENTRY (CHARACTER(*) VARYING,
                                CHARACTER(*) VARYING,
                                FIXED BINARY(15),
                                FIXED BINARY(31))
                                OPTIONS(VARIABLE) RETURNS (FIXED BINARY(31)),
        RMS$_EOF GLOBALREF FIXED BINARY(31) VALUE;
/* Repeat forever calling LIB$GET_FOREIGN to obtain
   subcommand text and print the text. Exit when an
   end-of-file is found. */
DO WHILE ('1'B); /* Do while TRUE */
    STS$VALUE = LIB$GET_FOREIGN
                (COMMAND_LINE,'Input: ',,
                 PROMPT_FLAG);
    IF STS$SUCCESS THEN
        PUT LIST (' Command was ',COMMAND_LINE);
    ELSE DO;
        IF STS$VALUE ^= RMS$_EOF THEN
            PUT LIST ('Error encountered');
        RETURN;
    END;
    PUT SKIP; /* Skip to next line */
END; /* End of DO WHILE loop */
END;
```

## LIB\$ Routines LIB\$GET\_FOREIGN

This PL/I example shows the use of the optional **flags** argument to permit repeated calls to LIB\$GET\_FOREIGN. The command line text is retrieved on the first pass only; after the first pass, the program prompts from SYS\$INPUT.

---

## LIB\$GET\_FULLNAME\_OFFSET

### Get the Offset to the Starting Position of the Most Significant Part of a Full Name

The Get the Offset to the Starting Position of the Most Significant Part of a Full Name routine returns the offset to the starting position of the most significant part of a full name.† The most significant part of a full name is determined by the underlying network services.

#### Format

LIB\$GET\_FULLNAME\_OFFSET fullname, offset

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### fullname

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Full name. The **fullname** argument contains the address of the descriptor pointing to this full name string.

The error LIB\$\_INVARG is returned if **fullname** contains an invalid full name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if **fullname** is an invalid descriptor.

##### offset

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

The offset in bytes of the starting position of the most significant part of **fullname**. The **offset** argument is the address of an unsigned word that contains this offset.

The **offset** argument contains an unusable result when LIB\$GET\_FULLNAME\_OFFSET returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## Description

This routine returns the byte offset of the starting position of the most significant part of the input full name. The returned offset can be used to position the display of a full name in a fixed-size output region, for example, scroll regions in DECwindows applications. The most significant part of a full name is determined by the underlying network services.

You must validate **fullname** by expanding it with LIB\$EXPAND\_NO DENAME before calling LIB\$GET\_FULLNAME\_OFFSET. LIB\$GET\_FULLNAME\_OFFSET returns the error LIB\$\_INVARG if **fullname** is invalid.

On a DECnet Phase IV system, processing a DECnet/OSI full name using LIB\$GET\_FULLNAME\_OFFSET results in the error condition LIB\$\_INVARG.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_INVARG    | Invalid argument: <ul style="list-style-type: none"><li>• <b>fullname</b> is invalid.</li><li>• <b>fullname</b> points to a null string.</li><li>• The length of the full name is more than 1024 characters.</li><li>• Processing a DECnet/OSI node name in a DECnet Phase IV system is invalid.</li></ul> |
| LIB\$_INVSTRDES | Invalid string descriptor.   |
| LIB\$_WRONUMARG | Wrong number of arguments.   |

Any condition value returned by the \$IPC DECnet service.

## Examples

The following table gives some examples of the results of LIB\$GET\_FULLNAME\_OFFSET:

| Full Name     | Offset |
|---------------|--------|
| NODE          | 0      |
| DEC:.FOO.NODE | 9      |

## LIB\$GET\_HOSTNAME Get Host Node Name

The Get Host Node Name routine returns the host node name of the local system.†

### Format

LIB\$GET\_HOSTNAME hostname [,resultant-length] [,flags]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### hostname

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

The host node name. The **hostname** argument contains the address of a descriptor pointing to the host node name. LIB\$GET\_HOSTNAME writes the host node-name string into the buffer pointed to by the **hostname** descriptor.

The error LIB\$\_INVSTRDES is returned if **hostname** is an invalid descriptor.

The length field of the **hostname** descriptor is not updated unless **hostname** is a dynamic descriptor with a length less than the host node name to be returned. Refer to the *OpenVMS RTL String Manipulation (STR\$) Manual* for dynamic string descriptor usage.

The **hostname** argument contains an unusable result when LIB\$GET\_HOSTNAME returns in error.

#### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the host node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB\$GET\_HOSTNAME returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

**flags**

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by value

The value LIB\$GET\_HOSTNAME uses to control the form of the host node name that it returns in the output descriptor **hostname**. If **flags** is equal to 0, or if **flags** is omitted, the host node name returned is in the network usable form. If **flags** is equal to 1, the host node name returned is in the parsable form.

Unused bits in **flags** must be 0. Nonzero unused bits result in the error condition LIB\$\_INVARG.

**Description**

This routine returns the host node name. The routine searches for the first host node name using the following order:

1. Get host node name from \$GETSYI system service.
2. Translate the executive mode logical SYS\$NODE\_FULLNAME once.
3. Translate the executive mode logical SYS\$NODE once.

The error LIB\$\_NOHOSNAM is returned if no host node name is found.

LIB\$GET\_HOSTNAME can return the host node name in the following two forms:

- Network usable form — The form that can be passed directly to the network. This form does not contain unnecessary double quotation marks (double quotation marks ["] that are not part of the node name) and also does not contain trailing double colons, for example: DEC:.FOO."simple name with spaces".
- Parsable form — The form that can be passed directly to the part of the system that does node-name syntax parsing, for example, \$FILESCAN and DCL command parsing. This form contains trailing double colons and is fully quoted if there are special characters. Individual double quotation marks (") that are part of a simple name are doubled (""), for example: "DEC:.FOO.""simple name with spaces""::.

You must use double quotation marks for a node name with special characters to facilitate correct parsing.

If the returned node name overflows the buffer pointed to by **hostname**, the host node name is truncated at the end, and the alternate success status LIB\$\_STRTRU is returned.

The **resultant-length** argument, if supplied, is set to the length of the node-name string copied to the output buffer pointed to by **hostname**.

## LIB\$ Routines

### LIB\$GET\_HOSTNAME

#### Condition Values Returned

|  |   |
|--|---|
| SS\$_NORMAL                                      | Routine successfully completed.   |
| LIB\$_STRTRU                                     | Routine successfully completed. Characters are truncated in the output buffer pointed to by <b>hostname</b> . |
| LIB\$_INVARG                                     | Invalid input argument. Unused bits in <b>flags</b> are not set to 0.   |
| LIB\$_INVSTRDES                                  | Invalid string descriptor.  |
| LIB\$_WRONUMARG                                  | Wrong number of arguments.  |
| LIB\$_NOHOSNAM                                   | No host node name found.  |
| Any condition value returned by LIB\$SCOPY_R_DX. |   |
| Any condition value returned by \$FILESCAN.      |   |

---

## LIB\$GET\_INPUT

### Get Line from SYS\$INPUT

The Get Line from SYS\$INPUT routine gets one record of ASCII text from the current controlling input device, specified by SYS\$INPUT.

#### Format

LIB\$GET\_INPUT resultant-string [,prompt-string] [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String that LIB\$GET\_INPUT gets from the input device. The **resultant-string** argument is the address of a descriptor pointing to the character string into which LIB\$GET\_INPUT writes the text received from the current input device.

##### prompt-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Prompt message that is displayed on the controlling terminal. The **prompt-string** argument is the address of a descriptor containing the prompt. Any string can be a valid prompt. By convention however, a prompt consists of text followed by a colon (:), a space, and no carriage-return/line-feed combination. The maximum size of the prompt message is 255 characters. If the controlling input device is not a terminal, this argument is ignored.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of bytes written into **resultant-string** by LIB\$GET\_INPUT, not counting padding in the case of a fixed string. The **resultant-length** argument is the address of an unsigned word containing this number. If the input string is truncated to the size specified in the **resultant-string** descriptor, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **resultant-string**.

## LIB\$ Routines

### LIB\$GET\_INPUT

#### Description

LIB\$GET\_INPUT uses the RMS \$GET service to get one record of ASCII text from the current controlling input device, specified by SYS\$INPUT. (For more information about the RMS \$GET service see the *OpenVMS Record Management Services Reference Manual*.)

When you log in, the OpenVMS operating system creates three files as default I/O control streams for your process.

- SYS\$INPUT, your default input device
- SYS\$OUTPUT, your default output device
- SYS\$COMMAND, the device that supplies the commands to your process

These files remain open until you log out. They are the interface between your interactive input and output or your batch commands and the OpenVMS software. Initially, all three names are equated with the terminal. However, with the DCL command ASSIGN, you can change these assignments to obtain information from a file or put information into a file. SYS\$INPUT and SYS\$COMMAND are usually identical, but the input and command streams can be different. For example, during the execution of an indirect command file from an interactive terminal, SYS\$COMMAND refers to the terminal and SYS\$INPUT refers to the command file.

LIB\$GET\_INPUT opens file SYS\$INPUT on the first call. The RMS internal stream identifier (ISI) is stored in the routine's static storage for subsequent calls. Hence, this routine is not AST reentrant.

If **prompt-string** is provided and the SYS\$INPUT device is a terminal, LIB\$GET\_INPUT displays the prompt message. If the device is not a terminal, the **prompt-string** argument is ignored.

If you want to get input from some source other than the current input stream, use LIB\$GET\_COMMAND.

#### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$NORMAL      | Routine successfully completed. RMS completion status.   |
| LIB\$_FATERRLIB | An internal consistency check on Run-Time Library data structures has failed. This may indicate a programming error in the Run-Time Library, or that your program may have overwritten those data structures.  |
| LIB\$_INPSTRTRU | The input string has been truncated to the size specified in the <b>resultant-string</b> descriptor (fixed-length strings only). The <b>resultant-length</b> argument is also set to this size. This is an error (as opposed to LIB\$_STRTRU, which is a success) because the truncation is not under program control. |
| LIB\$_INSVIRMEM | Insufficient virtual memory to allocate the dynamic string.  |

**LIB\$ Routines**  
**LIB\$GET\_INPUT**

LIB\$\_INVARG

Invalid arguments. The descriptor class field is not a recognized code or is zero.

Any RMS condition value returned by \$GET.

Any condition value returned by LIB\$GET\_VM, LIB\$GET\_VM\_64, LIB\$SCOPY\_R\_DX, or LIB\$SCOPY\_R\_DX\_64.

**LIB\$ Routines**  
**LIB\$GET\_INVO\_CONTEXT (Alpha Only)**

---

**LIB\$GET\_INVO\_CONTEXT (Alpha Only)**  
**Get Invocation Context**

The Get Invocation Context routine gets the invocation context of any active procedure.

**Format**

LIB\$GET\_INVO\_CONTEXT *invo\_handle*, *invo\_context*

**Returns**

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

A value of 1 indicates success; a value of 0 indicates failure.

**Arguments**

**invo\_handle**

OpenVMS usage: *invo\_handle*  
type: longword (unsigned)  
access: read only  
mechanism: by value

Handle for the desired invocation. Returned by LIB\$GET\_INVO\_HANDLE.

**invo\_context**

OpenVMS usage: *invo\_context\_blk*  
type: structure  
access: write only  
mechanism: by reference

Address of an invocation context block into which the procedure context of the frame specified by **invo\_handle** will be written.

**Description**

LIB\$GET\_INVO\_CONTEXT gets the invocation context of any active procedure.

---

**Note**

If the invocation handle that was passed does not represent any procedure context in the active call chain, the value of the new contents of the context block is unpredictable.

---

See the *OpenVMS Calling Standard* manual for additional information.

**LIB\$ Routines**  
**LIB\$GET\_INVO\_CONTEXT (Alpha Only)**

**Condition Values Returned**

None.

**LIB\$ Routines**  
**LIB\$GET\_INVO\_HANDLE (Alpha Only)**

---

**LIB\$GET\_INVO\_HANDLE (Alpha Only)**  
**Get Invocation Handle**

The Get Invocation Handle routine gets an invocation handle of any active procedure.

A thread can obtain an invocation handle corresponding to any invocation context block by using the following function format.

**Format**

LIB\$GET\_INVO\_HANDLE invo\_context

**Returns**

OpenVMS usage: invo\_handle  
type: longword (unsigned)  
access: write only  
mechanism: by value

Invocation handle of the invocation context that was passed. If the returned value is LIB\$K\_INVO\_HANDLE\_NULL, the invocation context that was passed was invalid.

**Argument**

**invo\_context**  
OpenVMS usage: invo\_context\_blk  
type: structure  
access: read only  
mechanism: by reference

Address of an invocation context block. Here, only the frame pointer and stack pointer fields of an invocation context block must be defined.

**Description**

LIB\$GET\_INVO\_HANDLE gets an invocation handle of any active procedure.  
See the *OpenVMS Calling Standard* manual for additional information.

**Condition Values Returned**

None.

---

## LIB\$GET\_LUN

### Get Logical Unit Number

The Get Logical Unit Number routine allocates one logical unit number from a processwide pool. If a unit is available, its number is returned to the caller. Otherwise, an error is returned as the function value.

#### Format

LIB\$GET\_LUN logical-unit-number

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

##### logical-unit-number

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Allocated logical unit number or -1 if none was available. The **logical-unit-number** argument is the address of a longword into which LIB\$GET\_LUN returns the value of the allocated logical unit. The logical unit numbers that LIB\$GET\_LUN can allocate are in the range 100 through 299.

#### Description

LIB\$GET\_LUN allocates one logical unit number from a processwide pool. If a unit is available, its number is returned to the caller. Otherwise, an error is returned as the function value.

LIB\$GET\_LUN reserves the logical unit numbers 100 through 299. To maintain compatibility, LIB\$GET\_LUN reserves logical unit numbers starting at 119 and continues in descending order through 100. When these are exhausted, LIB\$GET\_LUN reserves logical unit numbers starting at 299 and continues in descending order through 120.

LIB\$GET\_LUN assumes that the logical unit numbers in the range 0 through 99 may be in use by your program, but it cannot determine which logical unit numbers are actually in use by your program.

You should call LIB\$GET\_LUN only from Fortran or BASIC programs. Those languages and LIB\$GET\_LUN share the concept of unit numbers and a similar number space.

**LIB\$ Routines**  
**LIB\$GET\_LUN**

**Condition Values Returned**

SS\$\_NORMAL  
LIB\$\_INSLUN

Routine successfully completed.  
Insufficient logical unit numbers. No logical unit numbers were available.

---

## LIB\$GET\_MAXIMUM\_DATE\_LENGTH

### Retrieve the Maximum Length of a Date/Time String

Given an output format and language, the Retrieve the Maximum Length of a Date/Time String routine determines the maximum possible length for the **date-string** string returned by LIB\$FORMAT\_DATE\_TIME.

#### Format

LIB\$GET\_MAXIMUM\_DATE\_LENGTH date-length [,user-context] [,flags]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### date-length

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: write only  
mechanism: by reference

Receives the maximum possible length of the **date-string** argument returned to LIB\$FORMAT\_DATE\_TIME. The **date-length** argument is the address of a signed longword that receives this maximum length. The length written to **date-length** reflects the greatest possible length of an output date/time string for the currently selected output format and natural language.

For example, if the selected output date/time format includes the alphabetic, unabbreviated month name (assuming English as the natural language), the longest month name (September) would have to be taken into consideration when determining the maximum possible length of **date-string**.

##### user-context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context variable that retains the translation context over multiple calls to this routine. The **user-context** argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

The **user-context** parameter is optional. However, if a context cell is not passed, the routine LIB\$GET\_MAXIMUM\_DATE\_LENGTH may abort if two threads of execution attempt to manipulate the context area concurrently. Therefore, when calling this routine in situations where reentrancy might occur, such as from AST level, Digital recommends that users specify a different context cell for each calling thread.

## LIB\$ Routines

### LIB\$GET\_MAXIMUM\_DATE\_LENGTH

#### flags

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Bit mask that allows the user to specify whether the date, time, or both are to be included in the calculation of the maximum date length. The **flags** argument is the address of an unsigned bit mask containing the specified values. Valid values are LIB\$M\_DATE\_FIELDS and LIB\$M\_TIME\_FIELDS. The values specified for **flags** must correspond to the **flags** argument passed to LIB\$FORMAT\_DATE\_TIME.

#### Description

The LIB\$GET\_MAXIMUM\_DATE\_LENGTH routine determines the maximum possible length for a formatted date/time string as returned by LIB\$FORMAT\_DATE\_TIME. The maximum length returned takes into account the currently specified output format and natural language; **date-length** represents the maximum possible length of the string written to the **date-string** argument of LIB\$FORMAT\_DATE\_TIME.

Consider the following example, in which the output format is defined as follows.

```
DEFINE LIB$DT_FORMAT LIB$DATE_FORMAT_012, LIB$TIME_FORMAT_012
```

This date/time format would appear as follows:

```
!MAU !DD, !Y4 !HH2:!M0 !MIU
```

Given this format, the maximum possible length for this date/time string is calculated using the longest possible date string followed by a space and the longest possible time string. One example that meets these requirements is as follows (assuming English as the selected language):

```
SEPTEMBER 21, 1994 11:24 PM
```

The maximum possible length of this **date-string** would then be 28.

#### Condition Values Returned

|                  |   |
|------------------|---|
| SS\$_NORMAL      | Routine successfully completed.                             |
| LIB\$_ENGLUSED   | English used by default; unable to translate SYS\$LANGUAGE. |
| LIB\$_DEFFORUSE  | Default format used; unable to determine desired format.    |
| LIB\$_UNRFORCOD  | Unrecognized format code.                                   |
| LIB\$_STRTRU     | Output string truncated.                                    |
| LIB\$_ABSTIMREQ  | Absolute time required.                                     |
| LIB\$_REENTRANCY | Reentrant invocation with same context variable.            |

Any condition value returned by LIB\$GET\_VM.

---

## LIB\$GET\_PREV\_INVO\_CONTEXT (Alpha Only) Get Previous Invocation Context

The Get Previous Invocation Context routine gets the previous invocation context of any active procedure.

A thread can obtain the invocation context of the procedure context preceding any other procedure context using the following function format.

### Format

LIB\$GET\_PREV\_INVO\_CONTEXT    invo\_context

### Returns

OpenVMS usage: longword\_unsigned  
type:            longword (unsigned)  
access:          write only  
mechanism:        by value

Status value. A value of 1 indicates success. When the initial context represents the bottom of the call chain, a value of 0 is returned.

### Argument

**invo\_context**  
OpenVMS usage: invo\_context\_blk  
type:            structure  
access:          modify  
mechanism:        by reference

Address of an invocation context block. The given context block is updated to represent the context of the previous (calling) frame.

For the purposes of this function, the minimum fields of an invocation block that must be defined are those IREG and FREG fields corresponding to registers used by a context whether the registers are preserved or not. Note that the invocation context blocks written by the routines specified in these sections define all possible fields in a context block. Such context blocks satisfy this minimum requirement.

### Description

LIB\$GET\_PREV\_INVO\_CONTEXT gets the previous invocation context of any active procedure.

See the *OpenVMS Calling Standard* manual for additional information.

### Condition Values Returned

None.

## LIB\$GET\_PREV\_INVO\_HANDLE (Alpha Only) Get Previous Invocation Handle

The Get Previous Invocation Handle routine gets the previous invocation handle of any active procedure.

A thread can obtain an invocation handle of the procedure context preceding that of a specified procedure context by using the following function format.

### Format

```
LIB$GET_PREV_INVO_HANDLE  invo_handle
```

### Returns

OpenVMS usage: invo\_handle  
type: longword (unsigned)  
access: write only  
mechanism: by value

An invocation handle for the invocation context that is previous to that which was specified as the target.

### Argument

**invo\_handle**  
OpenVMS usage: invo\_handle  
type: longword (unsigned)  
access: read only  
mechanism: by value

An invocation handle that represents a target invocation context.

### Description

LIB\$GET\_PREV\_INVO\_HANDLE gets the previous invocation handle of any active procedure.

See the *OpenVMS Calling Standard* manual for additional information.

### Condition Values Returned

None.

---

## LIB\$GET\_SYMBOL

### Get Value of CLI Symbol

The Get Value of CLI Symbol routine requests the calling process's command language interpreter (CLI) to return the value of a CLI symbol as a string. LIB\$GET\_SYMBOL then returns the string to the caller. Optionally, LIB\$GET\_SYMBOL can return the length of the returned value and the table in which the symbol was found.

#### Format

LIB\$GET\_SYMBOL symbol ,resultant-string [,resultant-length] [,table-type-indicator]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### symbol

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name of the symbol for which LIB\$GET\_SYMBOL searches. The **symbol** argument is the address of a descriptor pointing to the name of the symbol. LIB\$GET\_SYMBOL converts the symbol name to uppercase and removes trailing blanks before the search. The **symbol** argument must begin with a letter, a digit, a dollar sign (\$), a hyphen (-), or an underscore (\_). The maximum length of **symbol** is 255 characters.

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Value of the returned symbol. The **resultant-string** argument is the address of a descriptor pointing to a character string into which LIB\$GET\_SYMBOL writes the value of the symbol.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the symbol value returned by LIB\$GET\_SYMBOL. The **resultant-length** argument is the address of an unsigned word integer into which LIB\$GET\_SYMBOL writes the length.

## LIB\$ Routines

### LIB\$GET\_SYMBOL

#### table-type-indicator

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by reference

Indicator of which table contained the symbol. The **table-type-indicator** argument is the address of a signed longword integer into which LIB\$GET\_SYMBOL writes the table indicator.

Possible values of the table indicator are listed below.

| Symbolic Name         | Value | Table               |
|-----------------------|-------|---------------------|
| LIB\$K_CLI_LOCAL_SYM  | 1     | Local symbol table  |
| LIB\$K_CLI_GLOBAL_SYM | 2     | Global symbol table |

LIB\$K\_CLI\_LOCAL\_SYM and LIB\$K\_CLI\_GLOBAL\_SYM are defined in Digital supplied symbol libraries (macro or module name \$LIBCLIDEF) and as global symbols.

## Description

LIB\$GET\_SYMBOL first searches the local symbol table for the symbol name, then searches the global symbol table. Numeric values are converted to an ASCII representation of a signed decimal number before being returned.

LIB\$GET\_SYMBOL is supported for use with the DCL command language interpreter. If used with the MCR CLI, the error status LIB\$\_NOCLI will be returned.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to get the symbol. In that case, LIB\$GET\_SYMBOL returns the error status LIB\$\_NOCLI.

## Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_STRTRU    | Routine successfully completed; string truncated. The destination string could not contain all the characters in the symbol value.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR).          |
| LIB\$_INSCLIMEM | Insufficient CLI memory. The CLI could not obtain enough virtual memory to perform the function. This may be caused by having too many symbols defined. Deleting some symbol definitions may relieve the situation. |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.  |

**LIB\$ Routines**  
**LIB\$GET\_SYMBOL**

|                 |  |
|-----------------|--|
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |
| LIB\$_INVSYMNAM | Invalid symbol name. The symbol name contained more than 255 characters or did not begin with a letter or dollar sign (\$).  |
| LIB\$_NOCLI     | No CLI present. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.  |
| LIB\$_NOSUCHSYM | No such symbol. The symbol was not defined in either the local or global symbol table.   |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to Digital in a Software Performance Report (SPR). |

## LIB\$ Routines

### LIB\$GET\_USERS\_LANGUAGE

---

## LIB\$GET\_USERS\_LANGUAGE

### Return the User's Language

The Return the User's Language routine determines the user's choice of a natural language. The choice is determined by translating the logical SYS\$LANGUAGE.

#### Format

LIB\$GET\_USERS\_LANGUAGE language

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**language**  
OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Receives the translation of SYS\$LANGUAGE. The **language** argument is the address of a descriptor pointing to this language name.

#### Description

The LIB\$GET\_USERS\_LANGUAGE routine translates the logical SYS\$LANGUAGE and returns the user's choice of a natural language. If the logical SYS\$LANGUAGE does not translate for some reason, then the language defaults to English and the status LIB\$\_ENGLUSED is returned.

If a failure or truncation occurs while copying the language name to the **language** string argument, that error status overrides the LIB\$\_ENGLUSED or SS\$\_NORMAL status.

#### Condition Values Returned

|                |   |
|----------------|---|
| SS\$_NORMAL    | Routine successfully completed.                             |
| LIB\$_ENGLUSED | English used by default; unable to translate SYS\$LANGUAGE. |

Any condition value returned by LIB\$SCOPY\_R\_DX.

---

## LIB\$GET\_VM

### Allocate Virtual Memory

The Allocate Virtual Memory routine allocates a specified number of contiguous bytes in the program region and returns the 32-bit virtual address of the first byte allocated.†

#### Format

LIB\$GET\_VM number-of-bytes, base-address [,zone-id]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-bytes

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of contiguous bytes that LIB\$GET\_VM allocates. The **number-of-bytes** argument is the address of a longword integer containing the number of bytes. LIB\$GET\_VM allocates enough memory to satisfy the request. Your program should not reference an address before the first byte address allocated (**base-address**) or beyond the last byte allocated (**base-address + number-of-bytes - 1**) since that space may be assigned to another routine. The value of **number-of-bytes** must be greater than zero.

##### base-address

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

First virtual address of the contiguous block of bytes allocated by LIB\$GET\_VM. The **base-address** argument is the address of an unsigned longword containing this base address.

##### zone-id

OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The **zone-id** argument is the address of a longword that contains a zone identifier created by a previous call to LIB\$CREATE\_VM\_ZONE or LIB\$CREATE\_USER\_

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$GET\_VM

VM\_ZONE. This argument is optional. If **zone-id** is omitted or if the longword contains the value 0, the LIB\$VM 32-bit default zone is used.

### Description

LIB\$GET\_VM satisfies an allocation request by re-using free memory in the zone, or by obtaining additional memory from the processwide 32-bit page pool managed by LIB\$GET\_VM\_PAGE.

LIB\$GET\_VM rounds up the value of **number-of-bytes** to a multiple of the **block-size** specified for the zone. The first byte allocated is aligned on the boundary specified by the alignment value for the zone.

If you specified allocation filling when you created the zone, LIB\$GET\_VM will fill each byte allocated. Otherwise, LIB\$GET\_VM does not initialize the memory and its contents are unpredictable.

All memory allocated by LIB\$GET\_VM has user mode read/write access, even if the call to LIB\$GET\_VM was made from a more privileged access mode.

The space allocated by successive calls to LIB\$GET\_VM may be noncontiguous because another routine can call LIB\$GET\_VM between your calls. If AST interrupts occur, LIB\$GET\_VM may allocate space to another routine between execution of any two statements in your program. Even if successive calls to LIB\$GET\_VM return two contiguous blocks, you must not combine them into one large block that is freed by a single call to LIB\$FREE\_VM.

LIB\$GET\_VM is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

Your program must retain the address of the allocated area. This allows you to access or deallocate the space later.

If the zone you are getting was created using the LIB\$CREATE\_USER\_VM\_ZONE routine, then you must have an appropriate action routine for the get operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE, you must have specified a **user-get-routine**.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$NORMAL      | Routine successfully completed.  |
| LIB\$INSVIRMEM  | Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.  |
| LIB\$_BADBLOSIZ | Bad block size. The value of <b>number-of-bytes</b> was less than or equal to 0. For the fixed-size blocks algorithm, LIB\$_BADBLOSIZ can also be generated if the value of <b>algorithm-argument</b> specified in the call to LIB\$CREATE_VM_ZONE is less than <b>number-of-bytes</b> . |
| LIB\$_BADBLOADR | Invalid <b>zone-id</b> or a corrupt zone.  |
| LIB\$_PAGLIMEXC | Allocation exceeds the <b>page-limit</b> , set when the zone was create.   |

---

## LIB\$GET\_VM\_64 (Alpha Only)

### Allocate Virtual Memory

The Allocate Virtual Memory routine allocates a specified number of contiguous bytes in the program region and returns the 64-bit virtual address of the first byte allocated.

#### Format

LIB\$GET\_VM\_64 number-of-bytes, base-address [,zone-id]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-bytes

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Number of contiguous bytes that LIB\$GET\_VM\_64 allocates. The **number-of-bytes** argument is the address of a quadword integer containing the number of bytes. LIB\$GET\_VM\_64 allocates enough memory to satisfy the request. Your program should not reference an address before the first byte address allocated (**base-address**) or beyond the last byte allocated (**base-address + number-of-bytes—1**) since that space may be assigned to another routine. The value of **number-of-bytes** must be greater than zero.

##### base-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

First virtual address of the contiguous block of bytes allocated by LIB\$GET\_VM\_64. The **base-address** argument is the address of an unsigned quadword containing this base address.

##### zone-id

OpenVMS usage: identifier  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

The **zone-id** argument is the address of a quadword that contains a zone identifier created by a previous call to LIB\$CREATE\_VM\_ZONE\_64 or LIB\$CREATE\_USER\_VM\_ZONE\_64. This argument is optional. If **zone-id** is omitted or if the quadword contains the value 0, the LIB\$VM 64-bit default zone is used.

## LIB\$ Routines

### LIB\$GET\_VM\_64 (Alpha Only)

#### Description

LIB\$GET\_VM\_64 satisfies an allocation request by reusing free memory in the zone, or by obtaining additional memory from the processwide 64-bit page pool managed by LIB\$GET\_VM\_PAGE\_64.

LIB\$GET\_VM\_64 rounds up the value of **number-of-bytes** to a multiple of the **block-size** specified for the zone. The first byte allocated is aligned on the boundary specified by the alignment value for the zone.

If you specified allocation filling when you created the zone, LIB\$GET\_VM\_64 will fill each byte allocated. Otherwise, LIB\$GET\_VM\_64 does not initialize the memory and its contents are unpredictable.

All memory allocated by LIB\$GET\_VM\_64 has user mode read/write access, even if the call to LIB\$GET\_VM\_64 was made from a more privileged access mode.

The space allocated by successive calls to LIB\$GET\_VM\_64 may be noncontiguous because another routine can call LIB\$GET\_VM\_64 between your calls. If AST interrupts occur, LIB\$GET\_VM\_64 may allocate space to another routine between execution of any two statements in your program. Even if successive calls to LIB\$GET\_VM\_64 return two contiguous blocks, you must not combine them into one large block that is freed by a single call to LIB\$FREE\_VM\_64.

LIB\$GET\_VM\_64 is fully reentrant, so it may be called by routines executing at AST level or in an Ada multitasking environment.

Your program must retain the address of the allocated area. This allows you to access or deallocate the space later.

If the zone you are getting was created using the LIB\$CREATE\_USER\_VM\_ZONE\_64 routine, then you must have an appropriate action routine for the get operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE\_64, you must have specified a **user-get-routine**.

#### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_INSVIRMEM | Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.   |
| LIB\$_BADBLOSIZ | Bad block size. The value of <b>number-of-bytes</b> was less than or equal to 0. For the fixed-size blocks algorithm, LIB\$_BADBLOSIZ can also be generated if the value of <b>algorithm-argument</b> specified in the call to LIB\$CREATE_VM_ZONE_64 is less than <b>number-of-bytes</b> . |
| LIB\$_BADBLOADR | Invalid <b>zone-id</b> or a corrupt zone.   |
| LIB\$_PAGLIMEXC | Allocation exceeds the <b>page-limit</b> , set when the zone was create.  |

---

## LIB\$GET\_VM\_PAGE

### Get Virtual Memory Page

The Get Virtual Memory Page routine allocates a specified number of contiguous pages on VAX systems or pagelets on Alpha systems of memory in the program region and returns the virtual address of the first allocated page on VAX or pagelet on Alpha.†

#### Format

LIB\$GET\_VM\_PAGE number-of-pages ,base-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-pages

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Number of pages on VAX systems or pagelets on Alpha systems. The **number-of-pages** argument is the address of a longword integer which specifies the number of contiguous pages on VAX systems or pagelets on Alpha systems to be allocated. The value of **number-of-pages** must be greater than 0.

##### base-address

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Block address. The **base-address** argument is the address of a longword which is set to the address of the first byte of the newly allocated block of pages on VAX systems or pagelets on Alpha systems.

#### Description

LIB\$GET\_VM\_PAGE allocates blocks of contiguous (512 byte) pages on VAX systems and pagelets on Alpha systems in the program region. LIB\$GET\_VM\_PAGE manages a processwide pool of free pages. If there are not enough contiguous free pages or pagelets to satisfy an allocation request, additional pages are created by calling the system service \$EXPREG. All memory allocated by LIB\$GET\_VM\_PAGE is pagelet aligned; that is, the low-order nine bits of the base address are zero.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$GET\_VM\_PAGE

All memory allocated by LIB\$GET\_VM\_PAGE has user-mode read/write access, even if the call to LIB\$GET\_VM\_PAGE is made from a more privileged access mode.

The contents of memory allocated by LIB\$GET\_VM\_PAGE are unpredictable. Your program must assign values to all locations that it uses.

LIB\$GET\_VM\_PAGE is designed for request sizes ranging from one page or pagelet to a few hundred pages or pagelets. For very large request sizes (over 1000 pages or pagelets in a single request), you should call the system service \$EXPREG.

LIB\$GET\_VM\_PAGE is fully reentrant, so it can be called by routines executing at AST level or in an Ada multitasking environment.

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_BADBLOSIZ | The value of the <b>number-of-pages</b> argument is less than or equal to 0.  |
| LIB\$_INSVIRMEM | Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case. |

---

## LIB\$GET\_VM\_PAGE\_64 (Alpha Only)

### Get Virtual Memory Page

The Get Virtual Memory Page routine allocates a specified number of contiguous Alpha pagelets of memory in the program region and returns the virtual address of the first allocated pagelet.

#### Format

LIB\$GET\_VM\_PAGE\_64 number-of-pages ,base-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-pages

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Number of Alpha pagelets. The **number-of-pages** argument is the address of a quadword integer that specifies the number of contiguous Alpha pagelets to be allocated. The value of **number-of-pages** must be greater than 0.

##### base-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Block address. The **base-address** argument is the address of a quadword that is set to the address of the first byte of the newly allocated block of Alpha pagelets.

#### Description

LIB\$GET\_VM\_PAGE\_64 allocates blocks of contiguous Alpha pagelets in the program region. LIB\$GET\_VM\_PAGE\_64 manages a processwide pool of free pagelets. If there are not enough contiguous free pagelets to satisfy an allocation request, additional pagelets are created by calling the system service \$EXPREG\_64. All memory allocated by LIB\$GET\_VM\_PAGE\_64 is aligned to physical page size.

All memory allocated by LIB\$GET\_VM\_PAGE\_64 has user-mode read/write access, even if the call to LIB\$GET\_VM\_PAGE\_64 is made from a more privileged access mode.

The contents of memory allocated by LIB\$GET\_VM\_PAGE\_64 are unpredictable. Your program must assign values to all locations that it uses.

LIB\$GET\_VM\_PAGE\_64 is fully reentrant, so it can be called by routines executing at AST level or in an Ada multitasking environment.

**LIB\$ Routines**  
**LIB\$GET\_VM\_PAGE\_64 (Alpha Only)**

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_BADBLOSIZ

The value of the argument **number-of-pages** is less than or equal to 0.

LIB\$\_INSVIRMEM

Insufficient virtual memory. The request required more dynamic memory than was available from the operating system. No partial allocation is made in this case.

---

## LIB\$ICHAR

### Convert First Character of String to Integer

The Convert First Character of String to Integer routine converts the first character of a source string to an 8-bit ASCII integer extended to a longword.

#### Format

LIB\$ICHAR source-string

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

First character of the source string. This character is returned by LIB\$ICHAR as an 8-bit ASCII value extended to a longword. If the source string has zero length, LIB\$ICHAR returns a zero.

#### Argument

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string whose first character is converted to an integer by LIB\$ICHAR. The **scr-str** argument is the address of a descriptor pointing to this source string.

#### Description

Although Fortran users can call LIB\$ICHAR, it is more efficient to use the Fortran intrinsic function ICHAR, which generates equivalent code in line.

#### Condition Values Returned

None.

#### Example

```
PROGRAM ICHAR(INPUT, OUTPUT);
{+}
{ This program demonstrates how to call LIB$ICHAR
{ to convert the first character of string to an
{ integer value.
{-}
FUNCTION LIB$ICHAR(SRCSTR : VARYING [A] OF CHAR) : INTEGER;
    EXTERN;

{+}
{ Declare the variables to be used.
{-}
```

## LIB\$ Routines

### LIB\$ICHAR

```
VAR
  CHARSTR      : VARYING [256] OF CHAR;
  RET_STATUS   : INTEGER;

{+}
{ Begin the main program. Read the character string,
{ call LIB$ICHAR, and print the result.
{-}

BEGIN
  WRITELN('Enter string: ');
  READLN(CHARSTR);
  RET_STATUS := LIB$ICHAR(CHARSTR);
  WRITELN(RET_STATUS);
END.
```

The output generated by this Pascal program is as follows:

```
$ RUN ICHAR
Enter string:
Pencil sharpener
      80
$ RUN ICHAR
Enter string:
pencil sharpener
      112
```

Notice that this routine changes any uppercase characters to lowercase.

---

## LIB\$INDEX

### Index to Relative Position of Substring

The Index to Relative Position of Substring routine returns an index, which is the relative position of the first occurrence of a substring in the source string.

#### Format

LIB\$INDEX source-string ,sub-string

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The relative position of the first character of the substring if found, or zero if not found.

#### Alpha

On Alpha systems, if the relative position of the substring can exceed  $2^{32} - 1$ , assign the return value to a quadword to ensure that you retrieve the correct relative position. ♦

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string to be searched by LIB\$INDEX. The **source-string** argument is the address of a descriptor pointing to this source string.

##### sub-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Substring to be found. The **sub-string** argument is the address of a descriptor pointing to this substring.

#### Description

The relative character positions returned by LIB\$INDEX are numbered 1, 2, ..., *n*. Zero means that the substring was not found.

If the substring has a zero length, LIB\$INDEX returns the value 1, indicating success, no matter how long the source string is. If the source string has a zero length and the substring has a nonzero length, zero is returned, indicating that the substring was not found.

Fortran users may use the built-in INDEX function rather than calling LIB\$INDEX directly.

**LIB\$ Routines**  
**LIB\$INDEX**

**Condition Values Returned**

None.

---

## LIB\$INIT\_DATE\_TIME\_CONTEXT

### Initialize the Context Area Used in Formatting Dates and Times for Input or Output

The Initialize the Context Area Used in Formatting Dates and Times for Input or Output routine allows the user to initialize the context area used by LIB\$FORMAT\_DATE\_TIME or LIB\$CONVERT\_DATE\_STRING with specific strings, instead of through logical name translation.

#### Format

LIB\$INIT\_DATE\_TIME\_CONTEXT user-context ,component ,init-string

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### user-context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

User context that retains the translation context over multiple calls to this routine. The **user-context** argument is the address of an unsigned longword that contains this context. The initial value of the context variable must be zero. Thereafter, the user program must not write to the cell.

##### component

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

The component of the context that is being initialized. The **component** argument is the address of a signed longword that indicates this component. Only one component can be initialized per call to LIB\$INIT\_DATE\_TIME; these component codes are shown in the following list.

- LIB\$K\_MONTH\_NAME
- LIB\$K\_MONTH\_NAME\_ABB
- LIB\$K\_FORMAT\_MNEMONICS
- LIB\$K\_WEEKDAY\_NAME
- LIB\$K\_WEEKDAY\_NAME\_ABB
- LIB\$K\_RELATIVE\_DAY\_NAME

## LIB\$ Routines

### LIB\$INIT\_DATE\_TIME\_CONTEXT

- LIB\$K\_MERIDIEM\_INDICATOR
- LIB\$K\_OUTPUT\_FORMAT
- LIB\$K\_INPUT\_FORMAT
- LIB\$K\_LANGUAGE

#### init-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

The characters which are to be used in formatting dates and times for input or output. The **init-string** argument is the address of a descriptor pointing to this string.

## Description

The LIB\$INIT\_DATE\_TIME\_CONTEXT routine allows the user to initialize the context area used by either LIB\$CONVERT\_DATE\_STRING or LIB\$FORMAT\_DATE\_TIME with specific strings instead of through logical name translations. This routine is therefore useful when the application is formatting either input or output strings that are used only by other computer applications and are not intended for presentation to users.

When the text will be parsed by another program, you must specify all of the context (including spellings). For applications where the context specifies a user's preferred format style, spellings can be looked up from the logical name tables.

Therefore, when the text will be parsed by another program, the minimum effort required to initialize the necessary format strings would be a call to LIB\$INIT\_DATE\_TIME\_CONTEXT specifying the input or output format strings to be used. If the specified format requires spelled items, such as month names or day names, then additional calls to LIB\$INIT\_DATE\_TIME\_CONTEXT are required to provide the spellings of these items. Applications where the context specifies a user's preferred format style can specify only the language name, and allow the strings to be looked up from logical name tables.

The format of the strings used by this routine is as follows:

[delim][string-1][delim] [string-2][delim] . . . [delim][string-n][delim]

In this format, [delim] is any character that is not in any of the strings, and [string-x] is the spelling of that instance of the component.

For example, a string passed to this routine to specify the English spellings of the month names might be as follows:

```
| JAN | FEB | MAR | APR | MAY | JUN  
| JUL | AUG | SEP | OCT | NOV | DEC |
```

Note that the string starts and ends with a delimiter. Thus, there is one more delimiter than there are string elements. Each type of component has a natural number of elements associated. The string must contain exactly that number of elements.

**LIB\$ Routines**  
**LIB\$INIT\_DATE\_TIME\_CONTEXT**

|                                   |    |
|-----------------------------------|----|
| Month names (full or abbreviated) | 12 |
| Format mnemonics                  | 9  |
| Day names (full or abbreviated)   | 7  |
| Relative day names                | 3  |
| Meridiem indicators               | 2  |
| Output format strings             | 2  |
| Input format string               | 1  |
| Language                          | 1  |

In order to specify the input format mnemonics using LIB\$INIT\_DATE\_TIME\_CONTEXT, the user must initialize the component LIB\$K\_FORMAT\_MNEMONICS with the appropriate values. The following table lists in order the 9 fields that must be initialized, along with their default (English) values.

| Order | Format Field           | Legible Mnemonic (Defaults) |
|-------|------------------------|-----------------------------|
| 1     | Year                   | YYYY                        |
| 2     | Numeric month          | MM                          |
| 3     | Numeric day            | DD                          |
| 4     | Hours (12- or 24-hour) | HH                          |
| 5     | Minutes                | MM                          |
| 6     | Seconds                | SS                          |
| 7     | Fractional seconds     | CC                          |
| 8     | Meridiem indicator     | AM/PM                       |
| 9     | Alphabetic month       | MONTH                       |

For example, the following would be a valid definition of LIB\$K\_FORMAT\_MNEMONICS using Austrian as the natural language:

```
|JJJJ|MM|TT|SS|MM|SS|HH| |MONAT|
```

To specify an output format using LIB\$INIT\_DATE\_TIME\_CONTEXT, the user must initialize the variable LIB\$K\_OUTPUT\_FORMAT. There are two elements associated with this output format string. One describes the date format fields, the other the time format fields. The order in which they appear in the string determines the order in which they are output. A single space is inserted into the output stream between the two elements, if the call to LIB\$FORMAT\_DATE\_TIME specifies that both be output. In the following example, the two elements associated with the output format string are delimited by vertical bars.

```
| !DB-!MAAU-!Y4 | !H04:!M0:!S0.!C2 |
```

This output format string represents the format used by the \$ASCTIM system service for outputting times. Note that the middle delimiter is replaced by a space in the resultant output.

See the *OpenVMS Programming Concepts Manual* for a description of system date and time operations as well as a detailed description of the format mnemonics used in these routines.

**LIB\$ Routines**  
**LIB\$INIT\_DATE\_TIME\_CONTEXT**

**Condition Values Returned**

|                    |   |
|--------------------|---|
| SS\$_NORMAL        | Routine successfully completed.                 |
| LIB\$_NUMELEMENTS  | Incorrect number of elements for the component. |
| LIB\$_ILLINISTR    | Illegally formed <b>init-string</b> .           |
| LIB\$_UNRFORCOD    | Unrecognized format code.                       |
| LIB\$_ILLCOMPONENT | Illegal value for the component.                |

Any condition value returned by LIB\$GET\_VM or LIB\$ANALYZE\_SDESC.

---

## LIB\$INIT\_TIMER

### Initialize Times and Counts

The Initialize Times and Counts routine stores the current values of specified times and counts for use by LIB\$SHOW\_TIMER or LIB\$STAT\_TIMER.

#### Format

LIB\$INIT\_TIMER [context]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**context**  
OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context variable that retains the values of the times and counts. The **context** argument contains the address of an unsigned longword that is this context. When you call LIB\$INIT\_TIMER, you must use the optional **context** argument only if you want to maintain several sets of statistics simultaneously.

- If **context** is omitted, the control block is allocated in static storage. This method is not AST reentrant.
- If **context** is zero, a control block is allocated in dynamic heap storage. The times and counts will be stored in that block and the address of the block returned in **context**. This method is fully reentrant and modular.
- If **context** is nonzero, it is considered to be the address of a control block previously allocated by a call to LIB\$INIT\_TIMER. If so, the control block is reused, and fresh times and counts are stored in it.

When LIB\$INIT\_TIMER returns, the block of storage referred to by **context** will contain the times and counts.

#### Description

LIB\$INIT\_TIMER stores the current values of specified times and counts in one of three places, depending on the value of the optional **context** argument.

You need to call LIB\$FREE\_TIMER only if you have specified **context** in LIB\$INIT\_TIMER and you want to deallocate all heap storage resources.

**LIB\$ Routines**  
**LIB\$INIT\_TIMER**

**Condition Values Returned**

SS\$\_NORMAL

LIB\$\_INVARG

LIB\$\_INSVIRMEM

Routine successfully completed.

Invalid argument; **context** is nonzero and the block to which it refers was not initialized on a previous call to LIB\$INIT\_TIMER.

The **context** argument is zero, and there is insufficient virtual memory to allocate a storage block.

---

## LIB\$INSERT\_TREE

### Insert Entry in a Balanced Binary Tree

The Insert Entry in a Balanced Binary Tree routine inserts a node in a balanced binary tree.†

#### Format

LIB\$INSERT\_TREE treehead ,symbol ,flags ,user-compare-routine ,user-allocation-procedure ,new-node  
[,user-data]

#### Returns

OpenVMS usage: cond\_value  
type: longword (signed)  
access: write only  
mechanism: by value

#### Arguments

##### treehead

OpenVMS usage: address  
type: address  
access: modify  
mechanism: by reference

Tree head for the binary tree. The **treehead** argument is the address of a longword that is this tree head. The initial value of **treehead** is 0.

##### symbol

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: unspecified  
mechanism: unspecified

Key to be inserted.

##### flags

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Control flags. The **flags** argument is the address of the control flags. Currently only bit 0 is used.

| Bit | Action if Set                   | Action if Clear  |
|-----|---------------------------------|--|
| 0   | Duplicate entries are inserted. | The address of the existing duplicate entry is returned to the <b>new-node</b> argument. |

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$INSERT\_TREE

#### **user-compare-routine**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied compare routine that LIB\$INSERT\_TREE calls to compare a symbol with a node. The **user-compare-routine** argument is required; LIB\$INSERT\_TREE calls the compare routine for every node except the first node in the tree. The value returned by the compare routine indicates the relationship between the symbol key and the node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

#### **user-allocation-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied allocate routine that LIB\$INSERT\_TREE calls to allocate virtual memory for a node. The **user-allocation-procedure** argument is required; LIB\$INSERT\_TREE always calls the allocate routine.

For more information on the allocate routine, see Call Format for an Allocate Routine in the Description section.

#### **new-node**

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Location where the new key is inserted. The **new-node** argument is the address of an unsigned longword that is the address of the new node.

#### **user-data**

OpenVMS usage: user\_arg  
type: unspecified  
access: unspecified  
mechanism: by value

User data that LIB\$INSERT\_TREE passes to the compare and allocate routines. The **user-data** argument is optional.

## Description

This Description section contains three parts:

- Guidelines for Using LIB\$INSERT\_TREE
- Call Format for a Compare Routine
- Call Format for an Allocate Routine

**Guidelines for Using LIB\$INSERT\_TREE**

LIB\$INSERT\_TREE inserts a node in a balanced binary tree. You supply two routines: compare and allocate. The compare routine compares the symbol key to the node, and the allocate routine allocates virtual memory for the node to be inserted. LIB\$INSERT\_TREE first calls the compare routine to find the location at which the new node is inserted. Then LIB\$INSERT\_TREE calls the allocate routine to allocate memory for the new node. Most programmers insert data in the new node by initializing it within the allocate routine as soon as memory has been allocated.

You may pass the data to be inserted into the tree using either the **symbol** argument alone or both the **symbol** and **user-data** arguments. The **symbol** argument is required. It may contain all of the data, just the name of the node, or the address of the data. If you decide to use **symbol** to pass just the name of the node, you must use the **user-data** argument to pass the rest of the data to be inserted in the new node.

**Call Format for a Compare Routine**

The call format of a compare routine is as follows:

**user-compare-routine** symbol ,comparison-node [,user-data]

LIB\$INSERT\_TREE passes both the **symbol** and **comparison-node** arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB\$INSERT\_TREE. The **user-data** argument is passed in the same way, but its use is optional.

The **user-compare-routine** argument in the call to LIB\$INSERT\_TREE specifies the compare routine. This argument is required. LIB\$INSERT\_TREE calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. The following table interprets the possible values returned by the compare routine:

| Return Value | Meaning  |
|--------------|--|
| Negative     | The <b>symbol</b> argument is less than the current node.    |
| Zero         | The <b>symbol</b> argument is equal to the current node.     |
| Positive     | The <b>symbol</b> argument is greater than the current node. |

This is an example of a user-supplied compare routine, written in C.

```
struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Compare_node(char* Key_string,
                        struct Full_node* Node,
                        void* Dummy)
```

## LIB\$ Routines

### LIB\$INSERT\_TREE

```
/*
** This function compares the string described by Key_string with
** the string contained in the data node Node, and returns 0
** if the strings are equal, -1 if Key_string is < Node, and
** 1 if Key_string > Node.
*/
{
    int result;

    result = strcmp(Key_string, Node->Text);
    if (result < 0)
        return -1;
    else if (result == 0)
        return 0;
    else
        return 1;
}
```

#### Call Format for an Allocate Routine

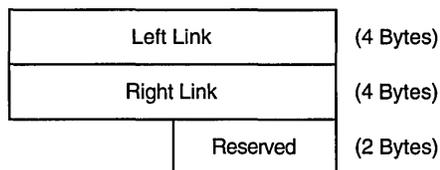
LIB\$INSERT\_TREE calls the allocate routine to allocate virtual memory for a node. The allocate routine then stores the value of **user-data** in the field of the allocated node.

The format of the call is as follows:

**user-allocation-procedure** symbol ,new-node [,user-data]

LIB\$INSERT\_TREE passes the **symbol**, **new-node**, and **user-data** arguments to your allocate routine, using the same passing mechanisms that were used to pass them to LIB\$INSERT\_TREE. Use of user data is optional.

A node header appears at the beginning of each node. The following figure shows the structure of a node header.

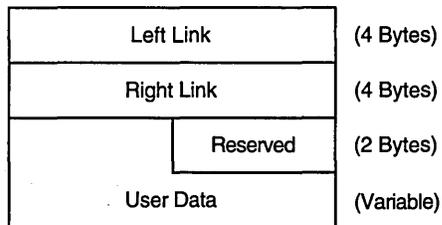


ZK-1926-GE

Therefore, any node you declare that LIB\$INSERT\_TREE manipulates must contain 10 bytes of reserved data at the beginning for the node header.

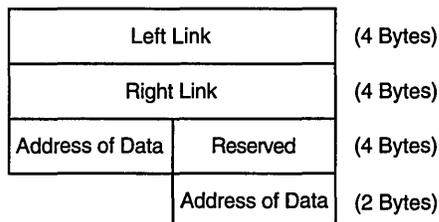
How a node is structured depends on how you allocate your user data. You can allocate data in one of two ways:

1. Your data immediately follows the node header. In this case, your allocation routine must allocate a block equal in size to the sum of your data plus 10 bytes for the node header, as shown in the following figure.



ZK-1927-GE

2. The node contains the 10 bytes of header information and a longword pointer to the user data, as shown in the following figure.



ZK-1928-GE

The **user-allocation-procedure** argument in the call to LIB\$INSERT\_TREE specifies the allocate routine. This argument is required. LIB\$INSERT\_TREE always calls the allocate routine.

Following is an example of a user-supplied allocate routine written in C.

```

struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Alloc_node(char* Key_string,
    struct Full_node** Ret_addr, void* Dummy)
{
    /*
    ** Allocate virtual memory for a new node. Key_string
    ** is the string to be entered into the newly
    ** allocated node. RET_ADDR will contain the address
    ** of the allocated memory.
    */
    long Status_code;
    long Alloc_size = sizeof(struct Full_node);
    extern long lib$get_vm();

    /*
    ** Allocate node: size of header, plus the length of our data.
    */
    Status_code = lib$get_vm (&Alloc_size, Ret_addr);
    if (!(Status_code & 1))
        lib$stop(Status_code);
}

```

## LIB\$ Routines

### LIB\$INSERT\_TREE

```
/*
** Store the data in the newly allocated virtual memory.
*/
strcpy((*Ret_addr)->Text, Key_string);
return (Status_code);
}
```

### Condition Values Returned

|                |   |
|----------------|---|
| LIB\$NORMAL    | Routine successfully completed.   |
| LIB\$KEYALRINS | Routine successfully completed, but a key was found in the tree. No new key was inserted. |
| LIB\$INSVIRMEM | Insufficient virtual memory. The user-supplied allocation routine returned an error.      |

Any other failure status reported by the user allocation procedure.

### Example

The following C program shows the use of LIB\$INSERT\_TREE, LIB\$LOOKUP\_TREE, and LIB\$TRAVERSE\_TREE.

```
/*
** This program asks the user to enter a series of strings,
** one per line. The user can then query the program to find
** strings that were previously entered. At the end, the entire
** tree is displayed, along with sequence numbers that
** indicate the order in which each element was entered.
**
** This program serves as an example of the use of LIB$INSERT_TREE,
** LIB$LOOKUP_TREE and LIB$TRAVERSE_TREE.
*/

#include <stdio.h>
#include <string.h>
#include <libdef.h>

char Text_line[80];

struct Tree_element /* Define the structure of our */
{ /* record. This record could */
    long Seq_num; /* contain many useful data items. */
    char Text[80];
};

struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    struct Tree_element my_node;
};

struct Tree_element Rec; /* Declare an instance of the record */

extern long lib$insert_tree(); /* Function to insert node */
extern long lib$traverse_tree(); /* Function to walk tree */
extern long lib$lookup_tree(); /* Function to find a node */
extern void lib$stop(); /* Routine to signal fatal error */
```

## LIB\$ Routines LIB\$INSERT\_TREE

```

static long Compare_node_2();      /* Compare entry (2 arg) */
static long Compare_node_3();      /* Compare entry (3 arg) */
static long Alloc_node();          /* Allocation entry */
static long Print_node();          /* Print entry for walk */
static void Display_Node();

main ()
{
    struct Full_node* Tree_head;    /* Head for the tree */
    struct Full_node* New_node;     /* New node after insert */
    long Status_code;              /* Return status code */
    long Counter;                  /* Sequence number */
    long flags = 1;

    /*
    ** Initialize the tree to null
    */
    Tree_head = NULL;

    printf("Enter one word per line, ^Z to begin searching the tree\n");

    /*
    ** Loop, reading lines of text until the end of the file.
    */
    Counter = 0;
    printf("> ");
    while (gets(Text_line))
    {
        Counter++;
        Rec.Seq_num = Counter;
        strcpy(Rec.Text, Text_line);
        Status_code = lib$insert_tree ( /* Insert the entry into the tree */
                                       &Tree_head, &Rec, &flags,
                                       Compare_node_3, Alloc_node, &New_node);
        if (!(Status_code & 1))
            lib$stop(Status_code);
        printf("> ");
    }

    /*
    ** End of file encountered. Begin searching the tree.
    */
    printf("\nYou will now be prompted for words to find. ");
    printf("Enter one per line.\n");

    Rec.Seq_num = -1;

    printf("Word to find? ");
    while (gets(Text_line))
    {
        strcpy(Rec.Text, Text_line);
        Status_code = lib$lookup_tree (&Tree_head, &Rec,
                                       Compare_node_2, &New_node);
        if (Status_code == LIB$KEYNOTFOU)
            printf("The word you entered does not appear in the tree.\n");
        else
            Display_Node(New_node);
        printf("Word to find? ");
    }

    /*
    ** The user has finished searching the tree for specific items. It
    ** is now time to traverse the entire tree.
    */
    printf("\n");
    printf("The following is a dump of the tree. Notice that the words\n");
    printf("are in alphabetical order\n");
}

```

## LIB\$ Routines

### LIB\$INSERT\_TREE

```
        Status_code = lib$traverse_tree(&Tree_head, Print_node, 0);
        return(Status_code);
    }

    static long Print_node(struct Full_node* Node, void* Dummy)
    {
        /*
        ** Print the string contained in the current node.
        */
        printf("%d\t%s\n", Node->my_node.Seq_num, Node->my_node.Text);
        return(LIB$NORMAL);
    }

    static long Alloc_node(struct Tree_element* Rec,
        struct Full_node** Ret_addr, void* Dummy)
    {
        /*
        ** Allocate virtual memory for a new node. Rec is the
        ** data record to be entered into the newly
        ** allocated node. RET_ADDR will contain the address
        ** of the allocated memory.
        */
        long Status_code;
        long Alloc_size = sizeof(struct Full_node);
        extern long lib$get_vm();

        /*
        ** Allocate node: size of header, plus the length of our data.
        */
        Status_code = lib$get_vm (&Alloc_size, Ret_addr);
        if (!(Status_code & 1))
            lib$stop(Status_code);

        /*
        ** Store the data in the newly allocated virtual memory.
        */
        (*Ret_addr)->my_node.Seq_num = Rec->Seq_num;
        strcpy((*Ret_addr)->my_node.Text, Rec->Text);
        return (Status_code);
    }

    static long Compare_node_3(struct Tree_element* Rec, struct Full_node* Node,
        void* Dummy)
    {
        /*
        ** Call the 2 argument version of the compare routine
        */
        return(Compare_node_2 ( Rec, Node ));
    }

    static long Compare_node_2(struct Tree_element* Rec, struct Full_node* Node)
    {
        /*
        ** This function compares the string described by Key_string with
        ** the string contained in the data node Node, and returns 0
        ** if the strings are equal, -1 if Key_string is < Node, and
        ** 1 if Key_string > Node.
        */
        int result;
```

```

/*
** Return the result of the comparison.
*/
result = strcmp(Rec->Text, Node->my_node.Text);
if (result < 0)
    return -1;
else if (result == 0)
    return 0;
else
    return 1;
}

static void Display_Node(struct Full_node* Node)
{
    /*
    ** This routine prints the data into the node of the tree
    ** once LIB$LOOKUP_TREE has been called to find the node.
    */
    printf("The sequence number for \"%s\" is %d\n",
        Node->my_node.Text, Node->my_node.Seq_num);
}

```

The output generated by this program is as follows:

```

$ run tree
Enter one word per line, ^Z to begin searching the tree
> apple
> orange
> peach
> pear
> grapefruit
> lemon
> CtrlZ

```

You will now be prompted for words to find. Enter one per line.

```

Word to find? lime
The word you entered does not appear in the tree

```

```

Word to find? orange
The sequence number for "orange" is 2

```

```

Word to find? CtrlZ

```

The following is a dump of the tree. Notice that the words are in alphabetical order

```

1      apple
5      grapefruit
6      lemon
2      orange
3      peach
4      pear
$

```

## LIB\$ Routines

### LIB\$INSERT\_TREE\_64 (Alpha Only)

---

## LIB\$INSERT\_TREE\_64 (Alpha Only)

### Insert Entry in a Balanced Binary Tree

The Insert Entry in a Balanced Binary Tree routine inserts a node in a balanced binary tree.

#### Format

LIB\$INSERT\_TREE\_64 treehead ,symbol ,flags ,user-compare-routine ,user-allocation-procedure  
,new-node [,user-data]

#### Returns

OpenVMS usage: cond\_value  
type: longword (signed)  
access: write only  
mechanism: by value

#### Arguments

##### treehead

OpenVMS usage: address  
type: address  
access: modify  
mechanism: by reference

Tree head for the binary tree. The **treehead** argument is the address of a quadword that is this tree head. The initial value of **treehead** is 0.

##### symbol

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: unspecified  
mechanism: unspecified

Key to be inserted.

##### flags

OpenVMS usage: mask\_quadword  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Control flags. The **flags** argument is the address of the control flags. Currently only bit 0 is used.

---

| Bit | Description  |
|-----|--|
| 0   | If clear, the address of the existing duplicate entry is returned to the <b>new-node</b> argument. If set, duplicate entries are inserted. |

---

**user-compare-routine**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied compare routine that LIB\$INSERT\_TREE\_64 calls to compare a symbol with a node. The **user-compare-routine** argument is required; LIB\$INSERT\_TREE\_64 calls the compare routine for every node except the first node in the tree. The value returned by the compare routine indicates the relationship between the symbol key and the node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

**user-allocation-procedure**

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied allocate routine that LIB\$INSERT\_TREE\_64 calls to allocate virtual memory for a node. The **user-allocation-procedure** argument is required; LIB\$INSERT\_TREE\_64 always calls the allocate routine.

For more information on the allocate routine, see Call Format for an Allocate Routine in the Description section.

**new-node**

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Location where the new key is inserted. The **new-node** argument is the address of an unsigned quadword that is the address of the new node.

**user-data**

OpenVMS usage: user\_arg  
type: unspecified  
access: unspecified  
mechanism: by value

User data that LIB\$INSERT\_TREE\_64 passes to the compare and allocate routines. The **user-data** argument is optional.

## Description

This Description section contains three parts:

- Guidelines for Using LIB\$INSERT\_TREE\_64
- Call Format for a Compare Routine
- Call Format for an Allocate Routine

## LIB\$ Routines

### LIB\$INSERT\_TREE\_64 (Alpha Only)

#### Guidelines for Using LIB\$INSERT\_TREE\_64

LIB\$INSERT\_TREE\_64 inserts a node in a balanced binary tree. You supply two routines: compare and allocate. The compare routine compares the symbol key to the node, and the allocate routine allocates virtual memory for the node to be inserted. LIB\$INSERT\_TREE\_64 first calls the compare routine to find the location at which the new node is inserted. Then LIB\$INSERT\_TREE\_64 calls the allocate routine to allocate memory for the new node. Most programmers insert data in the new node by initializing it within the allocate routine as soon as memory has been allocated.

You may pass the data to be inserted into the tree using either the **symbol** argument alone or both the **symbol** and **user-data** arguments. The **symbol** argument is required. It may contain all of the data, just the name of the node, or the address of the data. If you decide to use **symbol** to pass just the name of the node, you must use the **user-data** argument to pass the rest of the data to be inserted in the new node.

#### Call Format for a Compare Routine

The call format of a compare routine is as follows:

```
user-compare-routine symbol ,comparison-node [,user-data]
```

LIB\$INSERT\_TREE\_64 passes both the **symbol** and **comparison-node** arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB\$INSERT\_TREE\_64. The **user-data** argument is passed in the same way, but its use is optional.

The **user-compare-routine** argument in the call to LIB\$INSERT\_TREE\_64 specifies the compare routine. This argument is required. LIB\$INSERT\_TREE\_64 calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. Following are the possible values returned by the compare routine:

| Return Value | Meaning  |
|--------------|--|
| Negative     | The <b>symbol</b> argument is less than the current node.    |
| Zero         | The <b>symbol</b> argument is equal to the current node.     |
| Positive     | The <b>symbol</b> argument is greater than the current node. |

This is an example of a user-supplied compare routine, written in C.

```
struct Full_node
{
    void* left link;
    void* right link;
    short reserved;
    char Text[80];
};

static long Compare_node(char* Key string,
                        struct Full_node* Node,
                        void* Dummy)
```

## LIB\$ Routines LIB\$INSERT\_TREE\_64 (Alpha Only)

```
/*  
** This function compares the string described by Key_string with  
** the string contained in the data node Node, and returns 0  
** if the strings are equal, -1 if Key_string is < Node, and  
** 1 if Key_string > Node.  
*/  
{  
    int result;  
    result = strcmp(Key_string, Node->Text);  
    if (result < 0)  
        return -1;  
    else if (result == 0)  
        return 0;  
    else  
        return 1;  
}
```

### Call Format for an Allocate Routine

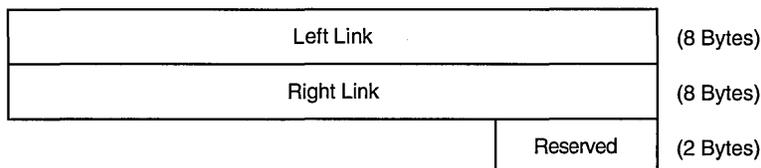
LIB\$INSERT\_TREE\_64 calls the allocate routine to allocate virtual memory for a node. The allocate routine then stores the value of **user-data** in the field of the allocated node.

The format of the call is as follows:

**user-allocation-procedure** symbol ,new-node [,user-data]

LIB\$INSERT\_TREE\_64 passes the **symbol**, **new-node**, and **user-data** arguments to your allocate routine, using the same passing mechanisms that were used to pass them to LIB\$INSERT\_TREE\_64. Use of user data is optional.

A node header appears at the beginning of each node. The following figure shows the structure of a node header.



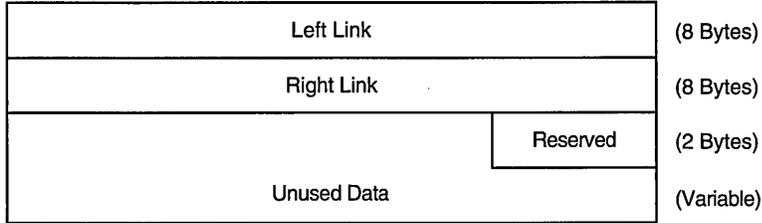
ZK-8082A-GE

Therefore, any node you declare that LIB\$INSERT\_TREE\_64 manipulates must contain 18 bytes of reserved data at the beginning for the node header.

How a node is structured depends on how you allocate your user data. You can allocate data in one of two ways:

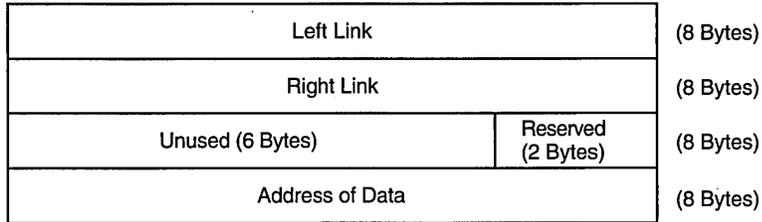
1. Your data immediately follows the node header. In this case, your allocation routine must allocate a block equal in size to the sum of your data plus 18 bytes for the node header, as shown in the following figure.

**LIB\$ Routines**  
**LIB\$INSERT\_TREE\_64 (Alpha Only)**



ZK-8083A-GE

2. The node contains the 18 bytes of header information and a quadword pointer to the user data as shown in the following figure.



ZK-8084A-GE

The **user-allocation-procedure** argument in the call to LIB\$INSERT\_TREE\_64 specifies the allocate routine. This argument is required. LIB\$INSERT\_TREE\_64 always calls the allocate routine.

This is an example of a user-supplied allocate routine written in C.

```

struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Alloc_node(char* Key_string,
    struct Full_node** Ret_addr, void* Dummy)
{
    /*
    ** Allocate virtual memory for a new node. Key_string
    ** is the string to be entered into the newly
    ** allocated node. RET_ADDR will contain the address
    ** of the allocated memory.
    */
    long Status_code;
    __int64 Alloc_size = sizeof(struct Full_node);
    extern long LIB$GET_VM_64();

    /*
    ** Allocate node: size of header, plus the length of our data.
    */

```

## LIB\$ Routines LIB\$INSERT\_TREE\_64 (Alpha Only)

```

Status_code = LIB$GET_VM_64 (&Alloc_size, Ret_addr);
if (!(Status_code & 1))
    lib$stop(Status_code);

/*
** Store the data in the newly allocated virtual memory.
*/
strcpy((*Ret_addr)->Text, Key_string);
return (Status_code);
}

```

### Condition Values Returned

|                 |   |
|-----------------|---|
| LIB\$_NORMAL    | Routine successfully completed.   |
| LIB\$_KEYALRINS | Routine successfully completed, but a key was found in the tree. No new key was inserted. |
| LIB\$_INSVIRMEM | Insufficient virtual memory. The user-supplied allocation procedure returned an error.    |

Any other failure status reported by the user allocation procedure.

### Example

The following C program shows the use of LIB\$INSERT\_TREE\_64, LIB\$LOOKUP\_TREE\_64, and LIB\$TRAVERSE\_TREE\_64.

```

/*
** This program asks the user to enter a series of strings,
** one per line. The user can then query the program to find
** strings that were previously entered. At the end, the entire
** tree is displayed, along with sequence numbers that
** indicate the order in which each element was entered.
**
** This program serves as an example of the use of LIB$INSERT_TREE_64,
** LIB$LOOKUP_TREE_64 and LIB$TRAVERSE_TREE_64.
*/

#pragma pointer_size long
#include <stdio.h>
#include <string.h>
#include <libdef.h>

char Text_line[80];

struct Tree_element /* Define the structure of our */
{ /* record. This record could */
    long Seq_num; /* contain many useful data items. */
    char Text[80];
};

struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    struct Tree_element my_node;
};

struct Tree_element Rec; /* Declare an instance of the record */

extern long lib$insert_tree_64(); /* Function to insert node */
extern long lib$traverse_tree_64(); /* Function to walk tree */
extern long lib$lookup_tree_64(); /* Function to find a node */
extern void lib$stop(); /* Routine to signal fatal error */

```

## LIB\$ Routines

### LIB\$INSERT\_TREE\_64 (Alpha Only)

```

static long Compare_node_2();      /* Compare entry (2 arg) */
static long Compare_node_3();      /* Compare entry (3 arg) */
static long Alloc_node();          /* Allocation entry */
static long Print_node();          /* Print entry for walk */
static void Display_Node();

main ()
{
    struct Full_node* Tree_head;    /* Head for the tree */
    struct Full_node* New_node;     /* New node after insert */
    long Status_code;               /* Return status code */
    long Counter;                   /* Sequence number */
    long flags = 1;

    /*
    ** Initialize the tree to null
    */
    Tree_head = NULL;

    printf("Enter one word per line, ^Z to begin searching the tree\n");

    /*
    ** Loop, reading lines of text until the end of the file.
    */
    Counter = 0;
    printf("> ");
    while (gets(Text_line))
    {
        Counter++;
        Rec.Seq_num = Counter;
        strcpy(Rec.Text, Text_line);
        Status_code = lib$insert_tree_64 ( /* Insert the entry into the tree */
                                         &Tree_head, &Rec, &flags,
                                         Compare_node_3, Alloc_node, &New_node);

        if (!(Status_code & 1))
            lib$stop(Status_code);
        printf("> ");
    }

    /*
    ** End of file encountered. Begin searching the tree.
    */
    printf("\nYou will now be prompted for words to find. ");
    printf("Enter one per line.\n");

    Rec.Seq_num = -1;

    printf("Word to find? ");
    while (gets(Text_line))
    {
        strcpy(Rec.Text, Text_line);
        Status_code = lib$lookup_tree_64 (&Tree_head, &Rec,
                                           Compare_node_2, &New_node);
        if (Status_code == LIB$KEYNOTFOU)
            printf("The word you entered does not appear in the tree.\n");
        else
            Display_Node(New_node);
        printf("Word to find? ");
    }

    /*
    ** The user has finished searching the tree for specific items. It
    ** is now time to traverse the entire tree.
    */
    printf("\n");
    printf("The following is a dump of the tree. Notice that the words\n");
    printf("are in alphabetical order\n");
}

```

**LIB\$ Routines**  
**LIB\$INSERT\_TREE\_64 (Alpha Only)**

```

    Status_code = lib$traverse_tree_64(&Tree_head, Print_node, 0);
    return(Status_code);
}

static long Print_node(struct Full_node* Node, void* Dummy)
{
    /*
    ** Print the string contained in the current node.
    */
    printf("%d\t%s\n", Node->my_node.Seq_num, Node->my_node.Text);
    return(LIB$NORMAL);
}

static long Alloc_node(struct Tree_element* Rec,
    struct Full_node** Ret_addr, void* Dummy)
{
    /*
    ** Allocate virtual memory for a new node. Rec is the
    ** data record to be entered into the newly
    ** allocated node. RET_ADDR will contain the address
    ** of the allocated memory.
    */
    long Status_code;
    __int64 Alloc_size = sizeof(struct Full_node);
    extern long lib$get_vm_64();

    /*
    ** Allocate node: size of header, plus the length of our data.
    */
    Status_code = lib$get_vm_64 (&Alloc_size, Ret_addr);
    if (!(Status_code & 1))
        lib$stop(Status_code);

    /*
    ** Store the data in the newly allocated virtual memory.
    */
    (*Ret_addr)->my_node.Seq_num = Rec->Seq_num;
    strcpy((*Ret_addr)->my_node.Text, Rec->Text);
    return (Status_code);
}

static long Compare_node_3(struct Tree_element* Rec, struct Full_node* Node,
    void* Dummy)
{
    /*
    ** Call the 2 argument version of the compare routine
    */
    return(Compare_node_2 ( Rec, Node ));
}

static long Compare_node_2(struct Tree_element* Rec, struct Full_node* Node)
{
    /*
    ** This function compares the string described by Key_string with
    ** the string contained in the data node Node, and returns 0
    ** if the strings are equal, -1 if Key_string is < Node, and
    ** 1 if Key_string > Node.
    */
    int result;

```

## LIB\$ Routines

### LIB\$INSERT\_TREE\_64 (Alpha Only)

```
/*
** Return the result of the comparison.
*/
result = strcmp(Rec->Text, Node->my_node.Text);
if (result < 0)
    return -1;
else if (result == 0)
    return 0;
else
    return 1;
}

static void Display_Node(struct Full_node* Node)
{
    /*
    ** This routine prints the data into the node of the tree
    ** once LIB$LOOKUP_TREE has been called to find the node.
    */
    printf("The sequence number for \"%s\" is %d\n",
        Node->my_node.Text, Node->my_node.Seq_num);
}
```

The output generated by this program is as follows:

```
$ run tree
Enter one word per line, ^Z to begin searching the tree
> apple
> orange
> peach
> pear
> grapefruit
> lemon
> CtrlZ
```

You will now be prompted for words to find. Enter one per line.

```
Word to find? lime
The word you entered does not appear in the tree
```

```
Word to find? orange
The sequence number for "orange" is 2
```

```
Word to find? CtrlZ
```

The following is a dump of the tree. Notice that the words are in alphabetical order

```
1         apple
5         grapefruit
6         lemon
2         orange
3         peach
4         pear
$
```

---

## LIB\$INSQHI

### Insert Entry at Head of Queue

The Insert Entry at Head of Queue routine inserts a queue entry at the head of the specified self-relative longword interlocked queue.† LIB\$INSQHI makes the INSQHI instruction available as a callable routine.

#### Format

LIB\$INSQHI entry ,header [,retry-count]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### entry

OpenVMS usage: unspecified  
type: unspecified  
access: modify  
mechanism: by reference, array reference

Entry to be inserted by LIB\$INSQHI. The **entry** argument contains the address of this signed quadword-aligned array that must be at least 8 bytes long. Bytes following the first 8 bytes can be used for any purpose by the calling program.

#### Alpha

For Alpha systems, the **entry** argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address. ♦

##### header

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue into which **entry** is to be inserted. The **header** argument contains the address of this signed aligned quadword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

#### Alpha

For Alpha systems, the **header** argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address. ♦

##### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$INSQHI

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of an unsigned longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

### Description

The queue into which LIB\$INSQHI inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

#### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB\$INSQHI, LIB\$INSQTI, LIB\$REMQHI, and LIB\$REMQTI routines to manage your self-relative longword queue on a VAX or an Alpha system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

#### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

#### Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run-Time Library routine LIB\$GET\_VM on a VAX or an Alpha system to allocate quadword-aligned virtual memory for a queue.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains more than one entry. |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains one entry.           |

|                 |   |
|-----------------|---|
| LIB\$_SECINTFAI | A secondary interlock failure occurred; the insertion was attempted the number of times specified by <b>retry-count</b> . This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors. |
| SS\$_ROPRAND    | Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.   |

## Examples

```
1. INTEGER*4 FUNCTION INSERT_Q (QENTRY)
COMMON/QUEUES/QHEADER
INTEGER*4 QENTRY(10), QHEADER(2)
INSERT_Q = LIB$INSQHI (QENTRY, QHEADER)
RETURN
END
```

This is a Fortran application using processor-shared memory.

```
2.      COM (QUEUES) QENTRY%(9), QHEADER%(1)
      EXTERNAL INTEGER FUNCTION LIB$INSQHI
      IF LIB$INSQHI (QENTRY%() BY REF, QHEADER%() BY REF) AND 1%
          THEN GOTO 1000
          .
          .
          .
1000 REM  INSERTED OK
```

In BASIC and Fortran, queues can be quadword aligned in a named COMMON block by using a linker option file to specify PSECT alignment. For instance, to create a COMMON block called QUEUES, use the LINK command with the FILE/OPTIONS qualifier, where FILE.OPT is a linker option file containing the following line:

```
PSECT = QUEUES, QUAD
```

## LIB\$INSQHIQ (Alpha Only) Insert Entry at Head of Queue

The Insert Entry at Head of Queue routine inserts a queue entry at the head of the specified self-relative quadword interlocked queue. LIB\$INSQHIQ makes the INSQHIQ instruction available as a callable routine.

### Format

LIB\$INSQHIQ entry ,header [,retry-count]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### entry

OpenVMS usage: unspecified  
type: unspecified  
access: modify  
mechanism: by reference, array reference

Entry to be inserted by LIB\$INSQHIQ. The **entry** argument contains the address of this signed octaword-aligned array that must be at least sixteen bytes long. Bytes following the first sixteen bytes can be used for any purpose by the calling program.

#### header

OpenVMS usage: octaword\_signed  
type: octaword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue into which **entry** is to be inserted. The **header** argument contains the address of this signed aligned octaword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

#### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of an unsigned longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

## Description

The queue into which LIB\$INSQHIQ inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or cross-processor queues.

### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB\$INSQHIQ, LIB\$INSQTIQ, LIB\$REMQHIQ, and LIB\$REMQTIQ routines to manage your self-relative quadword queue on an Alpha system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

### Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB\$GET\_VM\_64 to allocate octaword aligned virtual memory for a queue.

## Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains more than one entry.  |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was added to the front of the queue, and the resulting queue contains one entry.  |
| LIB\$_SECINTFAI | A secondary interlock failure occurred; the insertion was attempted the number of times specified by <b>retry-count</b> . This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors. |

## LIB\$ Routines LIB\$INSQHIQ (Alpha Only)

SS\$\_ROPRAND

Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.

### Example

The following Fortran application uses processor-shared memory:

```
INTEGER*4 FUNCTION INSERT_Q (QENTRY)
COMMON/QUEUES/QHEADER
INTEGER*8 QENTRY(10), QHEADER(2)
INSERT_Q = LIB$INSQHIQ (QENTRY, QHEADER)
RETURN
END
```

In Fortran, queues can be octaword aligned in a named COMMON block by using a linker option file to specify PSECT alignment. For instance, to create a COMMON block called QUEUES, use the LINK command with the FILE /OPTIONS qualifier, where FILE.OPT is a linker option file containing the following line:

```
PSECT = QUEUES, OCTA
```

---

## LIB\$INSQTI

### Insert Entry at Tail of Queue

The Insert Entry at Tail of Queue routine inserts a queue entry at the tail of the specified self-relative longword interlocked queue.† LIB\$INSQTI makes the INSQTI instruction available as a callable routine.

#### Format

LIB\$INSQTI entry ,header [,retry-count]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**entry**  
OpenVMS usage: unspecified  
type: unspecified  
access: modify  
mechanism: by reference, array reference

Entry to be inserted at the tail of the queue by LIB\$INSQTI. The **entry** argument contains the address of this signed quadword-aligned array that must be at least 8 bytes long. Bytes following the first 8 bytes can be used for any purpose by the calling program.

#### Alpha

For Alpha systems, the **entry** argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address. ♦

**header**  
OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue into which the queue entry is to be inserted. The **header** argument contains the address of this signed aligned quadword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$INSQTI

#### Alpha

For Alpha systems, the **header** argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address. ♦

#### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of a longword which contains the retry count value. The default value is 10.

## Description

The queue into which LIB\$INSQTI inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

#### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB\$INSQHI, LIB\$INSQTI, LIB\$REMQHI, and LIB\$REMQTI routines to manage your self-relative longword queue on a VAX or an Alpha system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

#### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

#### Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run-Time Library routine LIB\$GET\_VM on a VAX or an Alpha system to allocate quadword-aligned virtual memory for a queue.

## Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains more than one entry.   |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains one entry.   |
| LIB\$_SECINTFAI | A secondary interlock failure occurred; the insertion was attempted the number of times specified by <b>retry-count</b> . This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors. |
| SS\$_ROPRAND    | Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.   |

## LIB\$INSQTIQ (Alpha Only) Insert Entry at Tail of Queue

The Insert Entry at Tail of Queue routine inserts a queue entry at the tail of the specified self-relative quadword interlocked queue. LIB\$INSQTIQ makes the INSQTIQ instruction available as a callable routine.

### Format

LIB\$INSQTIQ entry ,header [,retry-count]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### entry

OpenVMS usage: unspecified  
type: unspecified  
access: modify  
mechanism: by reference, array reference

Entry to be inserted at the tail of the queue by LIB\$INSQTIQ. The **entry** argument contains the address of this signed octaword-aligned array that must be at least 16 bytes long. Bytes following the first 16 bytes can be used for any purpose by the calling program.

#### header

OpenVMS usage: octaword\_signed  
type: octaword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue into which the queue entry is to be inserted. The **header** argument contains the address of this signed aligned octaword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

#### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The number of times the insertion is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of a longword which contains the retry count value. The default value is 10.

## Description

The queue into which LIB\$INSQTIQ inserts an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB\$INSQHIQ, LIB\$INSQTIQ, LIB\$REMQHIQ, and LIB\$REMQTIQ routines to manage your self-relative quadword queue on an Alpha system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

### Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB\$GET\_VM\_64 to allocate octaword aligned virtual memory for a queue.

## Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains more than one entry.   |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was added to the tail of the queue: the resulting queue contains one entry.   |
| LIB\$_SECINTFAI | A secondary interlock failure occurred; the insertion was attempted the number of times specified by <b>retry-count</b> . This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors. |

**LIB\$ Routines**  
**LIB\$INSQTIQ (Alpha Only)**

SS\$\_ROPRAND

Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.

---

## LIB\$INSV

### Insert a Variable Bit Field

The Insert a Variable Bit Field routine replaces the variable bit field specified by the base, position, and size arguments with bits 0 through (**size**—1) of the source field. If the size of the bit field is zero, nothing is inserted. LIB\$INSV makes the VAX INSV instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$INSV longword-integer-source ,position ,size ,base-address

#### Returns

None.

#### Arguments

##### **longword-integer-source**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Source field to be inserted by LIB\$INSV. The **longword-integer-source** argument is the address of a signed longword integer that contains this source field.

##### **position**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Bit position relative to the base address where insertion of **longword-integer-source** is to begin. The **position** argument is the address of a longword integer that contains this relative bit position.

##### **size**

OpenVMS usage: byte\_unsigned  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Size of the bit field to be inserted by LIB\$INSV. The **size** argument is the address of an unsigned byte which contains the size of this bit field. The maximum size is 32 bits.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$ Routines

### LIB\$INSV

#### base-address

OpenVMS usage: address  
type: address  
access: read only  
mechanism: by value

Field into which LIB\$INSV writes the source field. The **base-address** argument is an unsigned longword containing the base address of this aligned bit string.

### Condition Value Signaled

SS\$\_ROPRAND                      A reserved operand fault is signaled if a size greater than 32 is specified.

### Examples

1. INTEGER\*4 COND\_VALUE  
CALL LIB\$INSV (4, 0, 3, COND\_VALUE)

This example shows how to set bits 0 through 2 of longword COND\_VALUE to the value 4 in Fortran.

2. DECLARE INTEGER COND\_VALUE  
CALL LIB\$INSV (4%, 0%, 3%, COND\_VALUE)

This example uses BASIC to set bits 0 through 2 of longword COND\_VALUE to the value 4.

---

## LIB\$INT\_OVER

### Integer Overflow Detection

The Integer Overflow Detection routine enables or disables integer overflow detection for the calling routine activation. The previous integer overflow enable setting is returned.†

#### Alpha

This routine is available on OpenVMS Alpha systems in translated form and is applicable to translated VAX images only. ♦

#### Format

LIB\$INT\_OVER new-setting

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

Old integer overflow enable setting (the previous contents of SF\$W\_PSW[PSW\$V\_IV] in the caller's frame).

#### Argument

##### new-setting

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

New integer overflow enable setting. The **new-setting** argument is the address of an unsigned longword which contains the new integer overflow enable setting. Bit 0 set to 1 means enable, bit 0 set to 0 means disable.

#### Description

The caller's stack frame will be modified by this routine.

LIB\$INT\_OVER affects only the current routine activation and does not affect any of its callers or any routines that it may call. However, the setting remains in effect for any routines which are subsequently entered through a JSB entry point.

#### Condition Values Returned

None.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines LIB\$INT\_OVER

### Example

```
INTOVF: ROUTINE OPTIONS (MAIN);
DECLARE LIB$INT_OVER ENTRY (FIXED BINARY (7)) /* Address of byte for
                                                /* enable/disable
                                                /* setting */
RETURN (FIXED BINARY (31)); /* Old setting */
DECLARE DISABLE FIXED BINARY (7) INITIAL (0) STATIC READONLY;
DECLARE (A,B) FIXED BINARY (7);

ON FIXEDOVERFLOW PUT SKIP LIST ('Overflow');

A = 127;
B = A + 2;
PUT LIST ('In MAIN');

BEGIN;

DECLARE RESULT FIXED BINARY (31);
/* Disable recognition of integer overflow in this block */
RESULT = LIB$INT_OVER (DISABLE);
B = A + 2;
PUT SKIP LIST ('In BEGIN block');

CALL Q;

Q: routine;
B = A + 2;
PUT LIST ('In Q');
END Q;

END /* Begin */;

END INTOVF;
```

This PL/I routine shows how to use LIB\$INT\_OVER to enable or disable the detection of integer overflow. Note that in PL/I, integer overflow is always enabled unless explicitly overridden by a call to this routine. However, disabling integer overflow is only effective for the block which calls this routine; descendent blocks are unaffected. The output generated by this PL/I program is as follows:

```
In MAIN
In BEGIN block
Overflow      In Q
```

---

## LIB\$LEN

### Length of String Returned as Longword Value

The Length of String Returned as Longword Value routine returns the length of a string.

#### Format

LIB\$LEN source-string

#### Returns

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by value

Length of the source string, extracted and zero-extended to 32 bits.

#### Argument

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string whose length is returned by LIB\$LEN. The **source-string** argument contains the address of a descriptor pointing to this source string.

#### Description

The BASIC and Fortran intrinsic function LEN generates equivalent in-line code at run time. Therefore, it is more efficient for BASIC and Fortran users to use the intrinsic function LEN than to call LIB\$LEN.

If you need both the length of the string and the address of its first byte, you should use LIB\$ANALYZE\_SDESC or LIB\$ANALYZE\_SDESC\_64.

#### Condition Values Returned

None.

## LIB\$LOCC

### Locate a Character

The Locate a Character routine locates a character in a string by comparing successive bytes in the string with the character specified. The search continues until the character is found or the string has no more characters. LIB\$LOCC makes the VAX LOCC instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$LOCC character-string ,source-string

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The relative position from the start of **source-string** to the first equal character or zero if no match is found.

#### Arguments

##### **character-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String whose initial character is used by LIB\$LOCC in the search. The **character-string** argument contains the address of a descriptor pointing to this string. Only the first character of **character-string** is used, and its length is not checked.

##### **source-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String to be searched by LIB\$LOCC. The **source-string** argument is the address of a descriptor pointing to this character string.

#### Description

LIB\$LOCC returns the position of the first equal character relative to the start of the source string as an index. An index is the relative position of the first occurrence of a substring in the source string. If no character matches or if the string has a length of zero, then a zero is returned, indicating that the character was not found.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

**Condition Values Returned**

None.

**Examples**

```

1. IDENTIFICATION DIVISION.
PROGRAM-ID.          LIBLOC.

ENVIRONMENT DIVISION.

DATA DIVISION.

WORKING-STORAGE SECTION.

01  SEARCH-STRING PIC X(26)
    VALUE "ABCDEFGHIJKLMNOPQRSTUVWXYZ".
01  SEARCH-CHAR   PIC X.
01  IND-POS       PIC 9(9) USAGE IS COMP.
01  DISP-IND      PIC 9(9).

ROUTINE DIVISION.

001-MAIN.
    MOVE SPACE TO SEARCH-CHAR.
    DISPLAY " ".
    DISPLAY "ENTER SEARCH CHARACTER: " WITH NO ADVANCING.
    ACCEPT SEARCH-CHAR.
    CALL "LIB$LOCC"
        USING BY DESCRIPTOR SEARCH-CHAR, SEARCH-STRING
        GIVING IND-POS.
    IF IND-POS = ZERO
        DISPLAY
            "CHAR ENTERED (" SEARCH-CHAR ") NOT A VALID SEARCH CHAR"
        STOP RUN.
    MOVE IND-POS TO DISP-IND.
    DISPLAY
        "SEARCH CHAR (" SEARCH-CHAR ") WAS FOUND IN POSITION "
        DISP-IND.
    GO TO 001-MAIN.

```

This COBOL program accepts a character as input and returns as output the character's position in a search string. The output generated by this COBOL program is as follows:

```

$ RUN LIBLOC
ENTER SEARCH CHARACTER: X
SEARCH CHAR (X) WAS FOUND IN POSITION 000000024

ENTER SEARCH CHARACTER: Y
SEARCH CHAR (Y) WAS FOUND IN POSITION 000000025

ENTER SEARCH CHARACTER: B
SEARCH CHAR (B) WAS FOUND IN POSITION 000000002

ENTER SEARCH CHARACTER: b
CHAR ENTERED (b) NOT A VALID SEARCH CHAR
$

```

Notice that uppercase and lowercase letters are not considered equal.

## LIB\$ Routines

### LIB\$LOCC

```
2. 10  !+
      ! This is an BASIC program demonstrating the
      ! use of LIB$LOCC.
      !-

      EXTERNAL INTEGER FUNCTION LIB$LOCC
      I% = 0
      CHARSTR$ = 'DAY'
      SRCSTR$ = 'ONE DAY AT A TIME'
      I% = LIB$LOCC(CHARSTR$, SRCSTR$)
      PRINT I%
90  END
```

This BASIC example also shows the use of LIB\$LOCC. The output generated by this BASIC program is "5".

---

## LIB\$LOOKUP\_KEY

### Look Up Keyword in Table

The Look Up Keyword In Table routine scans a table of keywords to find one that matches the keyword or keyword abbreviation specified by **search-string**.

#### Format

LIB\$LOOKUP\_KEY search-string ,key-table-array [,key-value] [,keyword-string] [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### search-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String for which LIB\$LOOKUP\_KEY will search in the keyword table. The **search-string** argument is the address of a descriptor pointing to this string.

##### key-table-array

OpenVMS usage: unspecified  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Keyword table. The **key-table-array** argument contains the address of an array that is this keyword table.

##### key-value

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Associated value of the keyword found by LIB\$LOOKUP\_KEY. The **key-value** argument contains the address of an unsigned longword into which LIB\$LOOKUP\_KEY writes the associated value of the matched keyword.

##### keyword-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Full keyword string matched. The **keyword-string** argument contains the address of a character string descriptor. LIB\$LOOKUP\_KEY writes the complete text of the matched keyword into the character string.

# LIB\$ Routines

## LIB\$LOOKUP\_KEY

### resultant-length

OpenVMS usage: word\_unsigned  
 type: word (unsigned)  
 access: write only  
 mechanism: by reference

Number of characters in the keyword, independent of padding. The **resultant-length** argument is the address of an unsigned word integer that contains the number of characters in the keyword. LIB\$LOOKUP\_KEY writes the length of the keyword into **resultant-length**.

### Description

LIB\$LOOKUP\_KEY is intended to help programmers to write utilities that have command qualifiers with values.

LIB\$LOOKUP\_KEY locates a matching keyword or keyword abbreviation by comparing the first *n* characters of each keyword in the keyword table with the supplied string, where *n* is the length of the supplied string.

When a keyword match is found, the following information is optionally returned to the caller:

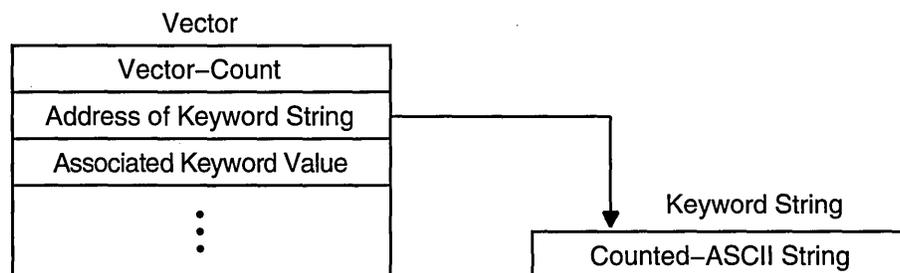
- The longword value associated with the matched keyword
- The full keyword string (any descriptor type)

An exact match is found if the length of the keyword found is equal to the length of the supplied string.

If an exact keyword match is found, no further processing is performed, and a normal return status is returned to the caller. Otherwise, after a match has been found, the rest of the keyword table is scanned. If an additional match is found, a “not enough characters” return status is returned to the caller. If the keyword table contains a keyword that is an abbreviation of another keyword in the table, an exact match can occur for short abbreviations.

Figure LIB-5 shows the structure of the keyword table, which the calling program creates for this routine.

Figure LIB-5 Keyword Table



ZK-1976-GE

**Vector-count** is the number of longwords that follow, and **counted-ASCII-string** starts with a byte that is the unsigned count of the number of ASCII characters that follow.

Because of the format of the keyword table, this routine cannot be called easily from high-level languages. The examples that follow show how to use a macro, `$LIB_KEY_TABLE`, to construct a keyword table from MACRO or BLISS. A separate example shows how a table could be constructed in Fortran.

Use of the `$LIB_KEY_TABLE` macro results in data that is not position-independent code (PIC). If your application requires PIC data, you must fill in the address of the keyword strings at execution time. See the Fortran example (example 3) for a demonstration of this technique.

### Condition Values Returned

|                              |   |
|------------------------------|---|
| <code>SS\$_NORMAL</code>     | Routine successfully completed. A unique keyword match was found.   |
| <code>LIB\$_AMBKEY</code>    | Multiple keyword match found. Not enough characters were specified to allow a unique match.                               |
| <code>LIB\$_INVARG</code>    | Invalid arguments, not enough arguments, and/or bad keyword table.  |
| <code>LIB\$_INSVIRMEM</code> | Insufficient virtual memory to return keyword string. This is only possible if <b>keyword-string</b> is a dynamic string. |
| <code>LIB\$_STRTRU</code>    | String truncated.   |
| <code>LIB\$_UNRKEY</code>    | The keyword you specified does not appear in the keyword table you specified.   |

### Examples

```
1. KEYTABLE:
   $LIB_KEY_TABLE < -
       <ADD, 1>, -
       <DELETE, 2>, -
       <EXIT, 3>>
```

This VAX MACRO fragment defines a keyword table named `KEYTABLE` containing the three keywords `ADD`, `DELETE`, and `EXIT` with associated keyword values of 1, 2, and 3, respectively.

The `$LIB_KEY_TABLE` macro is supplied in the default macro library `SYS$LIBRARY:STARLET.MLB`. Because this library is automatically searched by the assembler, you do not have to specify it in the DCL command `MACRO`.

```
2. LIBRARY 'SYS$LIBRARY:STARLET.L32';
   OWN
       KEYTABLE: $LIB_KEY_TABLE (
           (ADD, 1),
           (DELETE, 2),
           (EXIT, 3));
```

This BLISS code fragment specifies that `SYS$LIBRARY:STARLET.L32` is to be searched to resolve references. It defines a keyword table named `KEYTABLE` containing the three keywords `ADD`, `DELETE`, and `EXIT` with associated keyword values of 1, 2, and 3, respectively.

## LIB\$ Routines

### LIB\$LOOKUP\_KEY

The \$LIB\_KEY\_TABLE macro is supplied in the BLISS library SYS\$LIBRARY:STARLET.L32 and in the BLISS require file SYS\$LIBRARY:STARLET.REQ. BLISS does not automatically search either of these files, so you must explicitly cause them to be searched by including the appropriate LIBRARY or REQUIRE statement in your module. You should use the precompiled library because it is more efficient for the compiler.

```

3.  PARAMETER (
1     MAXKEYSIZE = 6,           ! Maximum keyword size
2     NKEYS = 3)              ! Number of keywords
    BYTE KEYWORDS (MAXKEYSIZE+1, NKEYS)
    INTEGER*4 KEYTABLE (0:NKEYS*2)
    DATA KEYWORDS /
1     3,'A','D','D',' ',' ',' ',' ',' ',' ',           ! Counted ASCII 'ADD'
2     6,'D','E','L','E','T','E',' ',' ',' ',           ! Counted ASCII 'DELETE'
3     4,'E','X','I','T',' ',' ',' ',' ',               ! Counted ASCII 'EXIT'

    KEYTABLE(0) = NKEYS*2           ! Number of longwords to follow
    KEYTABLE(1) = %LOC(KEYWORDS(1,1)) ! Address of keyword string
    KEYTABLE(2) = 1                 ! Keyword value for 'ADD'
    KEYTABLE(3) = %LOC(KEYWORDS(1,2)) ! Address of keyword string
    KEYTABLE(4) = 2                 ! Keyword value for 'DELETE'
    KEYTABLE(5) = %LOC(KEYWORDS(1,3)) ! Address of keyword string
    KEYTABLE(6) = 3                 ! Keyword value for 'EXIT'

```

This Fortran code fragment constructs a keyword table named KEYTABLE containing the three keywords ADD, DELETE, and EXIT with associated keyword values of 1, 2, and 3, respectively. This construction method results in position-independent coded data, although the generated code for the typical Fortran module contains other non-PIC values.

---

## LIB\$LOOKUP\_TREE

### Look Up an Entry in a Balanced Binary Tree

The Look Up an Entry in a Balanced Binary Tree routine looks up an entry in a balanced binary tree.†

#### Format

LIB\$LOOKUP\_TREE treehead ,symbol ,user-compare-routine ,new-node

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### treehead

OpenVMS usage: address  
type: address  
access: read only  
mechanism: by reference

Tree head for the binary tree. The **treehead** argument is the address of an unsigned longword that is this tree head.

##### symbol

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: unspecified  
mechanism: unspecified

Key to be looked up in the binary tree.

##### user-compare-routine

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied compare routine that LIB\$LOOKUP\_TREE calls to compare a symbol with a node. The value returned by the compare routine indicates the relationship between the symbol key and the current node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

##### new-node

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$LOOKUP\_TREE

Location where the new symbol was found. The **new-node** argument is the address of an unsigned longword that is the new node location.

## Description

### Call Format for a Compare Routine

The call format of a compare routine is as follows:

```
user-compare-routine symbol ,comparison-node [,user-data]
```

LIB\$LOOKUP\_TREE passes both the **symbol** and **comparison-node** arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB\$LOOKUP\_TREE. The **user-data** argument is passed in the same way, but its use is optional.

The **user-compare-routine** argument in the call to LIB\$LOOKUP\_TREE specifies the compare routine. This argument is required. LIB\$LOOKUP\_TREE calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. The table below lists the possible values returned by the compare routine:

| Return Value | Meaning  |
|--------------|--|
| Negative     | The <b>symbol</b> argument is less than the current node.    |
| Zero         | The <b>symbol</b> argument is equal to the current node.     |
| Positive     | The <b>symbol</b> argument is greater than the current node. |

For an example of a user-supplied compare routine written in C, see the description of LIB\$INSERT\_TREE.

## Condition Values Returned

|                 |  |
|-----------------|--|
| LIB\$_NORMAL    | Routine successfully completed. The key was found. |
| LIB\$_KEYNOTFOU | Error. The key was not found.                      |

## Example

The C example provided in the description of LIB\$INSERT\_TREE also demonstrates how to use LIB\$LOOKUP\_TREE. Refer to that example for assistance in using this routine.

---

## LIB\$LOOKUP\_TREE\_64 (Alpha Only)

### Look Up an Entry in a Balanced Binary Tree

The Look Up an Entry in a Balanced Binary Tree routine looks up an entry in a balanced binary tree.

#### Format

LIB\$LOOKUP\_TREE\_64 treehead ,symbol ,user-compare-routine ,new-node

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### treehead

OpenVMS usage: address  
type: address  
access: read only  
mechanism: by reference

Tree head for the binary tree. The **treehead** argument is the address of an unsigned quadword that is this tree head.

##### symbol

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: unspecified  
mechanism: unspecified

Key to be looked up in the binary tree.

##### user-compare-routine

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied compare routine that LIB\$LOOKUP\_TREE\_64 calls to compare a symbol with a node. The value returned by the compare routine indicates the relationship between the symbol key and the current node.

For more information on the compare routine, see Call Format for a Compare Routine in the Description section.

##### new-node

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Location where the new symbol was found. The **new-node** argument is the address of an unsigned quadword that is the new node location.

## LIB\$ Routines

### LIB\$LOOKUP\_TREE\_64 (Alpha Only)

#### Description

##### Call Format for a Compare Routine

The call format of a compare routine is as follows:

```
user-compare-routine symbol ,comparison-node [,user-data]
```

LIB\$LOOKUP\_TREE\_64 passes both the **symbol** and **comparison-node** arguments to the compare routine, using the same passing mechanism that was used to pass them to LIB\$LOOKUP\_TREE\_64. The **user-data** argument is passed in the same way, but its use is optional.

The **user-compare-routine** argument in the call to LIB\$LOOKUP\_TREE\_64 specifies the compare routine. This argument is required. LIB\$LOOKUP\_TREE\_64 calls the compare routine for every node except the first node in the tree.

The value returned by the compare routine is the result of comparing the symbol key with the current node. The following table lists the possible values returned by the compare routine:

| Return Value | Meaning  |
|--------------|--|
| Negative     | The <b>symbol</b> argument is less than the current node.    |
| Zero         | The <b>symbol</b> argument is equal to the current node.     |
| Positive     | The <b>symbol</b> argument is greater than the current node. |

For an example of a user-supplied compare routine written in C, see the description of LIB\$INSERT\_TREE\_64.

#### Condition Values Returned

|                |  |
|----------------|--|
| LIB\$NORMAL    | Routine successfully completed. The key was found. |
| LIB\$KEYNOTFOU | Error. The key was not found.                      |

#### Example

The C example provided in the description of LIB\$INSERT\_TREE\_64 also demonstrates how to use LIB\$LOOKUP\_TREE\_64. Refer to that example for assistance in using this routine.

---

## LIB\$LP\_LINES

### Lines on Each Printer Page

The Lines on Each Printer Page routine computes the default number of lines on a printer page. This routine can be used by native-mode OpenVMS utilities that produce listing files and paginate files.

#### Format

LIB\$LP\_LINES

#### Returns

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: write only  
mechanism: by value

The default number of lines on a physical printer page. If the logical name translation or conversion to binary fails, a default value of 66 is returned.

#### Arguments

None.

#### Description

LIB\$LP\_LINES computes the default number of lines on a printer page. This routine can be used by native-mode OpenVMS utilities that produce listing files and paginate files. The algorithm used by LIB\$LP\_LINES is:

1. Translate the logical name SYS\$LP\_LINES.
2. Convert the ASCII value obtained to a binary integer.
3. Verify that the resulting value is in the range [30:255].
4. If any of the prior steps fail, return the default paper size of 66 lines.

You can use LIB\$LP\_LINES to monitor the current default length of the line printer page. You can also supply your own default length for the current process. United States standard paper stock permits 66 lines on each physical page.

If you are writing programs for a utility that formats a listing file to be printed on a line printer, you can use LIB\$LP\_LINES to make your utility independent of the default page length. Your program can use LIB\$LP\_LINES to obtain the current length of the page. It can then calculate the number of lines of text on each page by subtracting the lines used for margins and headings.

## LIB\$ Routines

### LIB\$LP\_LINES

The following is one suggested format:

- Three lines for the top margin
- Three lines for the bottom margin
- Three lines for listing heading information, consisting of:
  - A language-processor identification line
  - A source-program identification line
  - One blank line

### Condition Values Returned

None.

### Examples

```
1.      lplines = LIB$LP_LINES()
        PRINT 10, lplines
10      Format (' Line printer page = ',I5,' lines.')
        end
```

This Fortran program displays the current default length of the line printer page.

```
2. 100 EXTERNAL INTEGER FUNCTION LIB$LP_LINES
    200 DECLARE INTEGER LPLINES
    300 LPLINES = LIB$LP_LINES
    400 PRINT "Line printer page = "; LPLINES
    32767 END
```

This BASIC program displays the current default length of the line printer page.

```
3. PROGRAM LINES(OUTPUT);
    FUNCTION LIB$LP_LINES : INTEGER;
        EXTERN;

    BEGIN
        WRITELN('Line printer page = ',LIB$LP_LINES,' lines.');
```

END.

This Pascal program displays the current default length of the line printer page.

---

## LIB\$MATCHC

### Match Characters, Return Relative Position

The Match Characters and Return Relative Position routine searches a source string for a specified substring and returns an index, which is the relative position of the first occurrence of a substring in the source string. The relative character positions returned by LIB\$MATCHC are numbered 1, 2, . . . , *n*. Thus, zero means that the substring was not found.

#### Format

LIB\$MATCHC sub-string ,source-string

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The relative position of the first character of the substring if found, or zero if not found.

#### Arguments

##### **sub-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Substring to be found. The **sub-string** argument is the address of a descriptor pointing to this substring.

##### **source-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string to be searched by LIB\$MATCHC. The **source-string** argument is the address of a descriptor pointing to this source string.

#### Description

LIB\$MATCHC searches a source string for a specified substring and returns an index, which is the relative position of the first occurrence of a substring in the source string.

The relative character positions returned by LIB\$MATCHC are numbered 1, 2, . . . , *n*. Thus, zero means that the substring was not found.

## **LIB\$ Routines**

### **LIB\$MATCHC**

If the substring has a zero length, LIB\$MATCHC returns the value 1, indicating success, no matter how long the source string is. If the source string has a zero length and the substring has a nonzero length, zero is returned, indicating that the substring was not found.

### **Condition Values Returned**

None.

---

## LIB\$MATCH\_COND

### Match Condition Values

The Match Condition Values routine checks to see if a given condition value matches a list of condition values that you supply.

#### Format

LIB\$MATCH\_COND match-condition-value ,compare-condition-value ,...

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

A zero, if the input condition value did not match any condition value in the list, or  $i - 1$ , for a match between the first argument and the  $i$ th argument.

#### Arguments

##### match-condition-value

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Condition value to be matched. The **match-condition-value** argument is the address of an unsigned longword that contains this condition value.

##### compare-condition-value

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The condition values to be compared to **match-condition-value**. The **compare-condition-value** arguments are the addresses of the unsigned longwords that contain these condition values.

#### Description

LIB\$MATCH\_COND checks for a match between the condition value addressed by **match-condition-value** and the condition values addressed by the subsequent arguments. Each argument is the address of a longword containing a condition value.

LIB\$MATCH\_COND is provided for programmers who want to match a list of one or more condition values. It is designed to be used in multipath branch statements available in most higher-level languages.

LIB\$MATCH\_COND compares the portion (STS\$V\_COND\_ID) of the condition value referenced by the first argument to the same portion of the condition value referenced by the second through Nth arguments. If the facility-specific bit (STS\$V\_FAC\_SP = bit 15) is clear in **match-condition-value** (meaning that the condition value is systemwide rather than facility specific), the facility code field

## LIB\$ Routines

### LIB\$MATCH\_COND

(STS\$V\_FAC\_NO = bits 27:17) is ignored and only the STS\$V\_MSG\_ID fields (bits 15:3) are compared.

The routine returns a 0 if a match is not found, a 1 if the condition value matches the first condition value in the list (the second argument), a 2 if it matches the second condition value (the third argument), and so on. LIB\$MATCH\_COND checks for null argument entries in the argument list.

When LIB\$MATCH\_COND is called with only two arguments, the possible values for the value returned are true (1) or false (0).

Each condition handler must examine the signal argument vector to determine which condition is being signaled. If the condition is not one that the handler knows about, the handler should resignal. A handler should not assume that only one kind of condition can occur in the routine which established it or in any routines it calls. However, because a condition value may be modified by an intervening handler, each handler should only compare that part of the condition value that distinguishes it from another.

### Condition Values Returned

None.

### Example

```
C+
C This Fortran program demonstrates the use of
C LIB$MATCH_COND.
C
C Declare handler routine as external.
C-
EXTERNAL    HANDLER
C+
C Declare the handler that will be used.
C-
        TYPE *, 'Establishing handler...'
        CALL LIB$ESTABLISH ( HANDLER )
        OPEN ( UNIT = 1, NAME = 'MATCH.DAT', STATUS = 'OLD' )
C+
C Revert to normal error processing.
C-
CALL LIB$REVERT
CLOSE ( UNIT = 1 )
CALL EXIT
END
C+
C This is the handler routine.
C-
INTEGER*4 FUNCTION HANDLER ( SIGARGS, MECHARGS )
INTEGER*4 SIGARGS(*), STATUS
INCLUDE '($SSDEF)'
INCLUDE '($FORDEF)'
INCLUDE '($CHFDEF)'
RECORD /CHFDEF2/ MECHARGS
HANDLER = SS$ _CONTINUE
C+
C This handler will type out an error message. In this case the
C message is regarding a file open status.
C-
TYPE *, 'Entering handler...'
STATUS = LIB$MATCH_COND ( SIGARGS ( 2 ) , FOR$ _FILNOTFOU,
        1          FOR$ _NO_SUCDEV, FOR$ _FILNAMSPE, FOR$ _OPEFAI )
```

**LIB\$ Routines**  
**LIB\$MATCH\_COND**

```
GOTO ( 100, 200, 300, 400 ) STATUS
HANDLER = SS$_RESIGNAL
GOTO 1000
100 TYPE *, 'ERROR -- File not found'
GOTO 1000
200 TYPE *, 'ERROR -- No such device'
GOTO 1000
300 TYPE *, 'ERROR -- File name specification'
GOTO 1000
400 TYPE *, 'ERROR -- Open failure'
GOTO 1000
C+
C On OpenVMS Alpha systems use MECHARGS.CHF$IS_MCH_DEPTH
C On OpenVMS VAX systems use MECHARGS.CHF$L_MCH_DEPTH
C-
1000 CALL SYS$UNWIND ( MECHARGS.CHF$IS_MCH_DEPTH , ) ! For OpenVMS Alpha
C 1000 CALL SYS$UNWIND ( MECHARGS.CHF$L_MCH_DEPTH , ) ! For OpenVMS VAX
TYPE *, 'Returning from handler...'
RETURN
END
```

This Fortran program uses a computed GOTO to alter the program execution sequence on a condition value.

If the file called MATCH.DAT does not exist, the following output is returned:

```
Establishing handler...
Entering handler...
ERROR -- File not found
Returning from handler...
```

If the file MATCH.DAT does exist, the output returned is as follows:

```
Establishing handler...
```

## LIB\$MOVC3 Move Characters

The Move Characters routine makes the VAX MOVC3 instruction available as a callable routine.<sup>1</sup> The source item is moved to the destination item. Overlap of the source and destination items does not affect the result.

### Format

LIB\$MOVC3 word-integer-length ,source ,destination

### Returns

None.

### Arguments

#### word-integer-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Number of bytes to be moved from **source** to **destination** by LIB\$MOVC3. The **word-integer-length** argument is the address of an unsigned word which contains this number of bytes. The maximum transfer is 65,535 bytes.

#### source

OpenVMS usage: unspecified  
type: unspecified  
access: read only  
mechanism: by reference

Item to be moved. The **source** argument is the address of this item.

#### destination

OpenVMS usage: unspecified  
type: unspecified  
access: write only  
mechanism: by reference

Item into which **source** will be moved. The **destination** argument is the address of this item.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

**Description**

LIB\$MOVC3 is useful for moving large blocks of data, such as arrays, when such an operation would otherwise have to be performed by a programmed loop.

For more information, see the *VAX Architecture Reference Manual* or the *Alpha Architecture Reference Manual*. See also OTS\$MOVE3.

**Condition Values Returned**

None.

## LIB\$MOVC5

### Move Characters with Fill

The Move Characters with Fill routine makes the VAX MOVC5 instruction available as a callable routine.<sup>1</sup> The source item is moved to the destination item. Overlap of the source and destination items does not affect the result.

#### Format

LIB\$MOVC5 word-integer-source-length ,source [,fill] ,word-integer-destination-length ,destination

#### Returns

None.

#### Arguments

##### **word-integer-source-length**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Number of bytes in the **source** item. The **word-integer-source-length** argument is the address of an unsigned word that contains this number of bytes. The maximum length of **source** is 65,535 bytes.

##### **source**

OpenVMS usage: unspecified  
type: unspecified  
access: read only  
mechanism: by reference

Item to be moved by LIB\$MOVC5. The **source** argument is the address of this item. If **word-integer-source-length** is zero, indicating that **destination** is to be entirely filled by the fill character, then **source** is ignored by LIB\$MOVC5.

##### **fill**

OpenVMS usage: byte\_signed  
type: byte integer (signed)  
access: read only  
mechanism: by reference

Character used to pad **source** to the length of **destination**. The **fill** argument is the address of a signed byte integer that contains this fill character. If **word-integer-destination-length** is greater than or equal to **word-integer-source-length**, **fill** is unused and may be omitted.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

**word-integer-destination-length**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Length of **destination** in bytes. The **word-integer-destination-length** argument is the address of an unsigned word that contains this number of bytes. The maximum value of **word-integer-destination-length** is 65,535 bytes.

**destination**

OpenVMS usage: unspecified  
type: unspecified  
access: write only  
mechanism: by reference

Item into which **source** will be moved. The **destination** argument is the address of this item.

**Description**

If the destination item is shorter than the source item, the highest-addressed bytes of the source are not moved.

For more information, see the *VAX Architecture Reference Manual*. See also OTS\$MOVE5.

**Condition Values Returned**

None.

## LIB\$MOVTC

### Move Translated Characters

The Move Translated Characters routine moves the source string, character by character, to the destination string after translating each character using the specified translation table. LIB\$MOVTC makes the VAX MOVTC instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$MOVTC source-string ,fill-character ,translation-table ,destination-string

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string to be translated and moved by LIB\$MOVTC. The **source-string** argument is the address of a descriptor pointing to this source string.

##### fill-character

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Fill character used to pad **source-string** to the length of **destination-string**. The **fill-character** argument is the address of a descriptor pointing to a string. The first character of this string is used as the fill character. The length of this string is not checked and **fill-character** is not translated.

##### translation-table

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Translation table used by LIB\$MOVTC. The **translation-table** argument is the address of a descriptor pointing to the translation table string. The translation table string is assumed to be 256 characters long.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

You can use any one of the translation tables included in the Description section that follows, or you can create your own. When you use a translation table supplied by Digital, the names LIB\$AB\_xxx\_yyy represent the addresses of the 256-byte translation tables, and can be accessed as external (string) variables. If a particular language cannot generate descriptors for external strings, then you must create them manually. The example following the Description section shows the creation of a string descriptor for a translation table using VAX BASIC.

**destination-string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string into which LIB\$MOVTC writes the translated **source-string**. The **destination-string** argument is the address of a descriptor pointing to this destination string.

**Description**

Each character in the source string is used as an index into the translation table. The byte found is then placed into the destination string. The fill character is used if the destination string is longer than the source string. If the source string is longer than the destination string, the source string is truncated. Overlap of the source and destination strings does not affect execution.

The translation tables used by LIB\$MOVTC and LIB\$MOVTUC follow. Each table is preceded by explanatory text.

**LIB\$ Routines**  
**LIB\$MOVTC**

**ASCII to EBCDIC Translation Table**

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent EBCDIC characters in hexadecimal notation.

Figure LIB-6 is the ASCII to EBCDIC translation table.

**Figure LIB-6 LIB\$AB\_ASC\_EBC**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 40 | F0 | 7C | D7 | 79 | 97 | 3F |
| 1                 | 01                   | 11 | 4F | F1 | C1 | D8 | 81 | 98 | 3F |
| 2                 | 02                   | 12 | 7F | F2 | C2 | D9 | 82 | 99 | 3F |
| 3                 | 03                   | 13 | 7B | F3 | C3 | E2 | 83 | A2 | 3F |
| 4                 | 37                   | 3C | 5B | F4 | C4 | E3 | 84 | A3 | 3F |
| 5                 | 2D                   | 3D | 6C | F5 | C5 | E4 | 85 | A4 | 3F |
| 6                 | 2E                   | 32 | 50 | F6 | C6 | E5 | 86 | A5 | 3F |
| 7                 | 2F                   | 26 | 7D | F7 | C7 | E6 | 87 | A6 | 3F |
| 8                 | 16                   | 18 | 4D | F8 | C8 | E7 | 88 | A7 | 3F |
| 9                 | 05                   | 19 | 5D | F9 | C9 | E8 | 89 | A8 | 3F |
| A                 | 25                   | 3F | 5C | 7A | D1 | E9 | 91 | A9 | 3F |
| B                 | 0B                   | 27 | 4E | 5E | D2 | 4A | 92 | C0 | 3F |
| C                 | 0C                   | 1C | 6B | 4C | D3 | E0 | 93 | 6A | 3F |
| D                 | 0D                   | 1D | 60 | 7E | D4 | 5A | 94 | D0 | 3F |
| E                 | 0E                   | 1E | 4B | 6E | D5 | 5F | 95 | A1 | 3F |
| F                 | 0F                   | 1F | 61 | 6F | D6 | 6D | 96 | 07 | 3F | FF |

ZK-4246-GE

**ASCII to EBCDIC Reversible Translation Table**

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represents the equivalent EBCDIC characters in hexadecimal notation.

Figure LIB-7 is the ASCII to EBCDIC reversible translation table.

**Figure LIB-7 LIB\$AB\_ASC\_EBC\_REV**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 40 | F0 | 7C | D7 | 79 | 97 | 20 | 30 | 41 | 58 | 76 | 9F | B8 | DC |
| 1                 | 01                   | 11 | 4F | F1 | C1 | D8 | 81 | 98 | 21 | 31 | 42 | 59 | 77 | A0 | B9 | DD |
| 2                 | 02                   | 12 | 7F | F2 | C2 | D9 | 82 | 99 | 22 | 1A | 43 | 62 | 78 | AA | BA | DE |
| 3                 | 03                   | 13 | 7B | F3 | C3 | E2 | 83 | A2 | 23 | 33 | 44 | 63 | 80 | AB | BB | DF |
| 4                 | 37                   | 3C | 5B | F4 | C4 | E3 | 84 | A3 | 24 | 34 | 45 | 64 | 8A | AC | BC | EA |
| 5                 | 2D                   | 3D | 6C | F5 | C5 | E4 | 85 | A4 | 15 | 35 | 46 | 65 | 8B | AD | BD | EB |
| 6                 | 2E                   | 32 | 50 | F6 | C6 | E5 | 86 | A5 | 06 | 36 | 47 | 66 | 8C | AE | BE | EC |
| 7                 | 2F                   | 26 | 7D | F7 | C7 | E6 | 87 | A6 | 17 | 08 | 48 | 67 | 8D | AF | BF | ED |
| 8                 | 16                   | 18 | 4D | F8 | C8 | E7 | 88 | A7 | 28 | 38 | 49 | 68 | 8E | B0 | CA | EE |
| 9                 | 05                   | 19 | 5D | F9 | C9 | E8 | 89 | A8 | 29 | 39 | 51 | 69 | 8F | B1 | CB | EF |
| A                 | 25                   | 3F | 5C | 7A | D1 | E9 | 91 | A9 | 2A | 3A | 52 | 70 | 90 | B2 | CC | FA |
| B                 | 0B                   | 27 | 4E | 5E | D2 | 4A | 92 | C0 | 2B | 3B | 53 | 71 | 9A | B3 | CD | FB |
| C                 | 0C                   | 1C | 6B | 4C | D3 | E0 | 93 | 6A | 2C | 04 | 54 | 72 | 9B | B4 | CE | FC |
| D                 | 0D                   | 1D | 60 | 7E | D4 | 5A | 94 | D0 | 09 | 14 | 55 | 73 | 9C | B5 | CF | FD |
| E                 | 0E                   | 1E | 4B | 6E | D5 | 5F | 95 | A1 | 0A | 3E | 56 | 74 | 9D | B6 | DA | FE |
| F                 | 0F                   | 1F | 61 | 6F | D6 | 6D | 96 | 07 | 1B | E1 | 57 | 75 | 9E | B7 | DB | FF |

ZK-4248-GE

**LIB\$ Routines**  
**LIB\$MOVTC**

**EBCDIC to ASCII Translation Table**

- The numbers on the left represent the low-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent ASCII characters in hexadecimal notation.

Figure LIB-8 is the EBCDIC to ASCII translation table.

**Figure LIB-8 LIB\$AB\_EBC\_ASC**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 5C | 5C | 20 | 26 | 2D | 5C | 5C | 5C | 5C | 5C | 7B | 7D | 5C | 30 |
| 1                 | 01                   | 11 | 5C | 5C | 5C | 5C | 2F | 5C | 61 | 6A | 7E | 5C | 41 | 4A | 5C | 31 |
| 2                 | 02                   | 12 | 5C | 16 | 5C | 5C | 5C | 5C | 62 | 6B | 73 | 5C | 42 | 4B | 53 | 32 |
| 3                 | 03                   | 13 | 5C | 5C | 5C | 5C | 5C | 5C | 63 | 6C | 74 | 5C | 43 | 4C | 54 | 33 |
| 4                 | 5C                   | 5C | 5C | 5C | 5C | 5C | 5C | 5C | 64 | 6D | 75 | 5C | 44 | 4D | 55 | 34 |
| 5                 | 09                   | 5C | 0A | 5C | 5C | 5C | 5C | 5C | 65 | 6E | 76 | 5C | 45 | 4E | 56 | 35 |
| 6                 | 5C                   | 08 | 17 | 5C | 5C | 5C | 5C | 5C | 66 | 6F | 77 | 5C | 46 | 4F | 57 | 36 |
| 7                 | 7F                   | 5C | 1B | 04 | 5C | 5C | 5C | 5C | 67 | 70 | 78 | 5C | 47 | 50 | 58 | 37 |
| 8                 | 5C                   | 18 | 5C | 5C | 5C | 5C | 5C | 5C | 68 | 71 | 79 | 5C | 48 | 51 | 59 | 38 |
| 9                 | 5C                   | 19 | 5C | 5C | 5C | 5C | 5C | 60 | 69 | 72 | 7A | 5C | 49 | 52 | 5A | 39 |
| A                 | 5C                   | 5C | 5C | 5C | 5B | 5D | 7C | 3A | 5C |
| B                 | 0B                   | 5C | 5C | 5C | 2E | 24 | 2C | 23 | 5C |
| C                 | 0C                   | 1C | 5C | 14 | 3C | 2A | 25 | 40 | 5C |
| D                 | 0D                   | 1D | 05 | 15 | 28 | 29 | 5F | 27 | 5C |
| E                 | 0E                   | 1E | 06 | 5C | 2B | 3B | 3E | 3D | 5C |
| F                 | 0F                   | 1F | 07 | 1A | 21 | 5E | 3F | 22 | 5C | FF |

ZK-4249-GE

**EBCDIC to ASCII Reversible Translation Table**

- The numbers on the left represent the low-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent ASCII characters in hexadecimal notation.

Figure LIB-9 is the EBCDIC to ASCII reversible translation table.

**Figure LIB-9 LIB\$AB\_EBC\_ASC\_REV**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |    |    |
| 0                 | 00                   | 10 | 80 | 90 | 20 | 26 | 2D | BA | C3 | CA | D1 | D8 | 7B | 7D | 5C | 30 |    |    |
| 1                 | 01                   | 11 | 81 | 91 | A0 | A9 | 2F | BB | 61 | 6A | 7E | D9 | 41 | 4A | 9F | 31 |    |    |
| 2                 | 02                   | 12 | 82 | 16 | A1 | AA | B2 | BC | 62 | 6B | 73 | DA | 42 | 4B | 53 | 32 |    |    |
| 3                 | 03                   | 13 | 83 | 93 | A2 | AB | B3 | BD | 63 | 6C | 74 | DB | 43 | 4C | 54 | 33 |    |    |
| 4                 | 04                   | 14 | 84 | 94 | A3 | AC | B4 | BE | 64 | 6D | 75 | DC | 44 | 4D | 55 | 34 |    |    |
| 5                 | 05                   | 15 | 85 | 0A | 95 | A4 | AD | B5 | BF | 65 | 6E | 76 | DD | 45 | 4E | 56 | 35 |    |
| 6                 | 06                   | 16 | 86 | 08 | 17 | 96 | A5 | AE | B6 | C0 | 66 | 6F | 77 | DE | 46 | 4F | 57 | 36 |
| 7                 | 07                   | 17 | 87 | 1B | 04 | A6 | AF | B7 | C1 | 67 | 70 | 78 | DF | 47 | 50 | 58 | 37 |    |
| 8                 | 08                   | 18 | 88 | 98 | A7 | B0 | B8 | C2 | 68 | 71 | 79 | E0 | 48 | 51 | 59 | 38 |    |    |
| 9                 | 09                   | 19 | 89 | 99 | A8 | B1 | B9 | 60 | 69 | 72 | 7A | E1 | 49 | 52 | 5A | 39 |    |    |
| A                 | 0A                   | 1A | 8A | 9A | 5B | 5D | 7C | 3A | C4 | CB | D2 | E2 | E8 | EE | F4 | FA |    |    |
| B                 | 0B                   | 1B | 8B | 9B | 2E | 24 | 2C | 23 | C5 | CC | D3 | E3 | E9 | EF | F5 | FB |    |    |
| C                 | 0C                   | 1C | 8C | 14 | 3C | 2A | 25 | 40 | C6 | CD | D4 | E4 | EA | F0 | F6 | FC |    |    |
| D                 | 0D                   | 1D | 05 | 15 | 28 | 29 | 5F | 27 | C7 | CE | D5 | E5 | EB | F1 | F7 | FD |    |    |
| E                 | 0E                   | 1E | 06 | 9E | 2B | 3B | 3E | 3D | C8 | CF | D6 | E6 | EC | F2 | F8 | FE |    |    |
| F                 | 0F                   | 1F | 07 | 1A | 21 | 5E | 3F | 22 | C9 | D0 | D7 | E7 | ED | F3 | F9 | FF |    |    |

ZK-4250-GE

**LIB\$ Routines**  
**LIB\$MOVTC**

**Packed Decimal to Trailing Overpunch Numeric Value Translation Table**

- The numbers on the left represent the low-order bits of the packed decimal values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the packed decimal values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent trailing overpunch numeric values in hexadecimal notation.

Figure LIB-10 is the packed decimal to trailing overpunch numeric value translation table.

**Figure LIB-10 LIB\$AB\_CVTPT\_O**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 1                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 2                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 3                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 4                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 5                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 6                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 7                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 8                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| 9                 | 7B                   | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B | 7B |
| A                 | 7B                   | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 7B | 7B | 7B | 7B | 7B | 7B |
| B                 | 7D                   | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 7B | 7B | 7B | 7B | 7B | 7B |
| C                 | 7B                   | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 7B | 7B | 7B | 7B | 7B | 7B |
| D                 | 7D                   | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 7B | 7B | 7B | 7B | 7B | 7B |
| E                 | 7B                   | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 7B | 7B | 7B | 7B | 7B | 7B |
| F                 | 7B                   | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 7B | 7B | 7B | 7B | 7B | 7B |

ZK-4251-GE

**Packed Decimal to Unsigned Trailing Numeric Value Translation Table**

- The numbers on the left represent the low-order bits of the packed decimal values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the packed decimal values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent unsigned trailing numeric values in hexadecimal notation.

Figure LIB-11 is the packed decimal to unsigned trailing numeric value translation table.

**Figure LIB-11 LIB\$AB\_CVTPT\_U**

| Row<br>Bits 0 - 3 | Column Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 1                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 2                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 3                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 4                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 5                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 6                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 7                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 8                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 9                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| A                 | 30                | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 00 | 00 | 00 | 00 | 00 | 00 |
| B                 | 30                | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 00 | 00 | 00 | 00 | 00 | 00 |
| C                 | 30                | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 00 | 00 | 00 | 00 | 00 | 00 |
| D                 | 30                | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 00 | 00 | 00 | 00 | 00 | 00 |
| E                 | 30                | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 00 | 00 | 00 | 00 | 00 | 00 |
| F                 | 30                | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 00 | 00 | 00 | 00 | 00 | 00 |

ZK-4252-GE

**LIB\$ Routines**  
**LIB\$MOVTC**

**Trailing Overpunch Numeric to Packed Decimal Value Translation Table**

- The numbers on the left represent the low-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent packed decimal values in hexadecimal notation.

Figure LIB-12 is the trailing overpunch numeric to packed decimal value translation table.

**Figure LIB-12 LIB\$AB\_CVTPP\_O**

| Row<br>Bits 0 - 3 | Column Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                | 00 | 00 | 0C | 00 | 7D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 1                 | 00                | 00 | 0D | 1C | 1C | 8D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 2                 | 00                | 00 | 00 | 2C | 2C | 9D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 3                 | 00                | 00 | 00 | 3C | 3C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 4                 | 00                | 00 | 00 | 4C | 4C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 5                 | 00                | 00 | 00 | 5C | 5C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 6                 | 00                | 00 | 00 | 6C | 6C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 7                 | 00                | 00 | 00 | 7C | 7C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 8                 | 00                | 00 | 00 | 8C | 8C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 9                 | 00                | 00 | 00 | 9C | 9C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| A                 | 00                | 00 | 00 | 0D | 1D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| B                 | 00                | 00 | 00 | 00 | 2D | 0C | 00 | 0C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| C                 | 00                | 00 | 00 | 00 | 3D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| D                 | 00                | 00 | 00 | 00 | 4D | 0D | 00 | 0D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| E                 | 00                | 00 | 00 | 00 | 5D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| F                 | 00                | 00 | 00 | 0C | 6D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

ZK-4253-GE

**Unsigned Numeric to Packed Decimal Value Translation Table**

- The numbers on the left represent the low-order bits of the unsigned numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the unsigned numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent packed decimal values in hexadecimal notation.

Figure LIB-13 is the unsigned numeric to packed decimal value translation table.

**Figure LIB-13 LIB\$AB\_CVTP\_U**

| Row<br>Bits 0 - 3 | Column Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                | 00 | 00 | 0C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 1                 | 00                | 00 | 00 | 1C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 2                 | 00                | 00 | 00 | 2C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 3                 | 00                | 00 | 00 | 3C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 4                 | 00                | 00 | 00 | 4C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 5                 | 00                | 00 | 00 | 5C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 6                 | 00                | 00 | 00 | 6C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 7                 | 00                | 00 | 00 | 7C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 8                 | 00                | 00 | 00 | 8C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 9                 | 00                | 00 | 00 | 9C | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| A                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| B                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| C                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| D                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| E                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| F                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

ZK-4254-GE

**LIB\$ Routines**  
**LIB\$MOVTC**

**Trailing Overpunch Numeric to Unsigned Numeric Value Translation Table**

- The numbers on the left represent the low-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the trailing overpunch numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent unsigned numeric values in hexadecimal notation.

Figure LIB-14 is the trailing overpunch numeric to unsigned numeric value translation table.

**Figure LIB-14 LIB\$AB\_CVT\_O\_U**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 20 | 30 | 40 | 37 | 60 | 70 | 80 | 90 | A0 | B0 | C0 | D0 | E0 | F0 |
| 1                 | 01                   | 11 | 30 | 31 | 31 | 38 | 61 | 71 | 81 | 91 | A1 | B1 | C1 | D1 | E1 | F1 |
| 2                 | 02                   | 12 | 22 | 32 | 32 | 39 | 62 | 72 | 82 | 92 | A2 | B2 | C2 | D2 | E2 | F2 |
| 3                 | 03                   | 13 | 23 | 33 | 33 | 53 | 63 | 73 | 83 | 93 | A3 | B3 | C3 | D3 | E3 | F3 |
| 4                 | 04                   | 14 | 24 | 34 | 34 | 54 | 64 | 74 | 84 | 94 | A4 | B4 | C4 | D4 | E4 | F4 |
| 5                 | 05                   | 15 | 25 | 35 | 35 | 55 | 65 | 75 | 85 | 95 | A5 | B5 | C5 | D5 | E5 | F5 |
| 6                 | 06                   | 16 | 26 | 36 | 36 | 56 | 66 | 76 | 86 | 96 | A6 | B6 | C6 | D6 | E6 | F6 |
| 7                 | 07                   | 17 | 27 | 37 | 37 | 57 | 67 | 77 | 87 | 97 | A7 | B7 | C7 | D7 | E7 | F7 |
| 8                 | 08                   | 18 | 28 | 38 | 38 | 58 | 68 | 78 | 88 | 98 | A8 | B8 | C8 | D8 | E8 | F8 |
| 9                 | 09                   | 19 | 29 | 39 | 39 | 59 | 69 | 79 | 89 | 99 | A9 | B9 | C9 | D9 | E9 | F9 |
| A                 | 0A                   | 1A | 2A | 30 | 31 | 5A | 6A | 7A | 8A | 9A | AA | BA | CA | DA | EA | FA |
| B                 | 0B                   | 1B | 2B | 3B | 32 | 30 | 6B | 30 | 8B | 9B | AB | BB | CB | DB | EB | FB |
| C                 | 0C                   | 1C | 2C | 3C | 33 | 5C | 6C | 7C | 8C | 9C | AC | BC | CC | DC | EC | FC |
| D                 | 0D                   | 1D | 2D | 3D | 34 | 30 | 6D | 30 | 8D | 9D | AD | BD | CD | DD | ED | FD |
| E                 | 0E                   | 1E | 2E | 3E | 35 | 5E | 6E | 7E | 8E | 9E | AE | BE | CE | DE | EE | FE |
| F                 | 0F                   | 1F | 2F | 30 | 36 | 5F | 6F | 7F | 8F | 9F | AF | BF | CF | DF | EF | FF |

ZK-4255-GE

**Unsigned Numeric to Trailing Overpunch Translation Table**

Figure LIB-15 is indexed by 0 through 9 for the positive overpunches and 10 through 19 for the negative overpunches.

The unsigned binary representation of the least significant digit is moved into R2. Then, if you require a positive result, the following code results:

```
MOV3 LIB$AB_CVT_U_O[R2], #1,R0
```

If you require a negative result, the following code is generated:

```
MOV3 LIB$AV_CVT_U_O + 10[R2], #1,R0
```

The result is the overpunch representation for the last byte of the negative number.

Figure LIB-15 is the unsigned numeric to trailing overpunch translation table.

**Figure LIB-15 LIB\$AB\_CVT\_U\_O**

| 0 - 9                         | 10 - 19                       |
|-------------------------------|-------------------------------|
| 7B 41 42 43 44 45 46 47 48 49 | 7D 4A 4B 4C 4D 4E 4F 50 51 52 |

ZK-4256-GE

**LIB\$ Routines**  
**LIB\$MOVTC**

**Packed Decimal to Zone Numeric Translation Table**

- The numbers on the left represent the low-order bits of the packed decimal values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the packed decimal values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent zoned numeric values in hexadecimal notation.

Figure LIB-16 is the packed decimal to zone numeric translation table.

**Figure LIB-16 LIB\$AB\_CVTPT\_Z**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 1                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 2                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 3                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 4                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 5                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 6                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 7                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 8                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 9                 | 30                   | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| A                 | 30                   | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 30 | 30 | 30 | 30 | 30 | 30 |
| B                 | 70                   | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 30 | 30 | 30 | 30 | 30 | 30 |
| C                 | 30                   | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 30 | 30 | 30 | 30 | 30 | 30 |
| D                 | 70                   | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 30 | 30 | 30 | 30 | 30 | 30 |
| E                 | 30                   | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 30 | 30 | 30 | 30 | 30 | 30 |
| F                 | 30                   | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 30 | 30 | 30 | 30 | 30 | 30 |

ZK-6414-GE

**Zone to Packed Decimal Translation Table**

- The numbers on the left represent the low-order bits of the zoned numeric values in hexadecimal notation.
- The numbers across the top represent the high-order bits of the zoned numeric values in hexadecimal notation.
- The numbers in the body of the table represent the equivalent packed decimal values in hexadecimal notation.

Figure LIB-17 is the zone to packed decimal translation table.

**Figure LIB-17 LIB\$AB\_CVTP\_Z**

| Row<br>Bits 0 - 3 | Column Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|-------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                | 00 | 00 | 0C | 00 | 00 | 00 | 0D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 1                 | 00                | 00 | 00 | 1C | 00 | 00 | 00 | 1D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 2                 | 00                | 00 | 00 | 2C | 00 | 00 | 00 | 2D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 3                 | 00                | 00 | 00 | 3C | 00 | 00 | 00 | 3D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 4                 | 00                | 00 | 00 | 4C | 00 | 00 | 00 | 4D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 5                 | 00                | 00 | 00 | 5C | 00 | 00 | 00 | 5D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 6                 | 00                | 00 | 00 | 6C | 00 | 00 | 00 | 6D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 7                 | 00                | 00 | 00 | 7C | 00 | 00 | 00 | 7D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 8                 | 00                | 00 | 00 | 8C | 00 | 00 | 00 | 8D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| 9                 | 00                | 00 | 00 | 9C | 00 | 00 | 00 | 9D | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| A                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| B                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| C                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| D                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| E                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| F                 | 00                | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

ZK-6415-GE

**LIB\$ Routines**  
**LIB\$MOVTC**

**ASCII Uppercase Translation Table**

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent uppercase ASCII characters in hexadecimal notation.

Figure LIB-18 is the ASCII uppercase translation table.

**Figure LIB-18 LIB\$AB\_UPCASE**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 20 | 30 | 40 | 50 | 60 | 50 | 80 | 90 | A0 | B0 | C0 | D0 | C0 | F0 |
| 1                 | 01                   | 11 | 21 | 31 | 41 | 51 | 41 | 51 | 81 | 91 | A1 | B1 | C1 | D1 | C1 | F1 |
| 2                 | 02                   | 12 | 22 | 32 | 42 | 52 | 42 | 52 | 82 | 92 | A2 | B2 | C2 | D2 | C2 | F2 |
| 3                 | 03                   | 13 | 23 | 33 | 43 | 53 | 43 | 53 | 83 | 93 | A3 | B3 | C3 | D3 | C3 | F3 |
| 4                 | 04                   | 14 | 24 | 34 | 44 | 54 | 44 | 54 | 84 | 94 | A4 | B4 | C4 | D4 | C4 | F4 |
| 5                 | 05                   | 15 | 25 | 35 | 45 | 55 | 45 | 55 | 85 | 95 | A5 | B5 | C5 | D5 | C5 | F5 |
| 6                 | 06                   | 16 | 26 | 36 | 46 | 56 | 46 | 56 | 86 | 96 | A6 | B6 | C6 | D6 | C6 | F6 |
| 7                 | 07                   | 17 | 27 | 37 | 47 | 57 | 47 | 57 | 87 | 97 | A7 | B7 | C7 | D7 | C7 | F7 |
| 8                 | 08                   | 18 | 28 | 38 | 48 | 58 | 48 | 58 | 88 | 98 | A8 | B8 | C8 | D8 | C8 | F8 |
| 9                 | 09                   | 19 | 29 | 39 | 49 | 59 | 49 | 59 | 89 | 99 | A9 | B9 | C9 | D9 | C9 | F9 |
| A                 | 0A                   | 1A | 2A | 3A | 4A | 5A | 4A | 5A | 8A | 9A | AA | BA | CA | DA | CA | DA |
| B                 | 0B                   | 1B | 2B | 3B | 4B | 5B | 4B | 7B | 8B | 9B | AB | BB | CB | DB | CB | DB |
| C                 | 0C                   | 1C | 2C | 3C | 4C | 5C | 4C | 7C | 8C | 9C | AC | BC | CC | DC | CC | DC |
| D                 | 0D                   | 1D | 2D | 3D | 4D | 5D | 4D | 7D | 8D | 9D | AD | BD | CD | DD | CD | DD |
| E                 | 0E                   | 1E | 2E | 3E | 4E | 5E | 4E | 7E | 8E | 9E | AE | BE | CE | DE | CE | FE |
| F                 | 0F                   | 1F | 2F | 3F | 4F | 5F | 4F | 7F | 8F | 9F | AF | BF | CF | DF | CF | FF |

ZK-6416-GE

**ASCII Lowercase Translation Table**

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent lowercase ASCII characters in hexadecimal notation.

Figure LIB-19 is the ASCII lowercase translation table.

**Figure LIB-19 LIB\$AB\_LOWERCASE**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 20 | 30 | 40 | 70 | 60 | 70 | 80 | 90 | A0 | B0 | E0 | D0 | E0 | F0 |
| 1                 | 01                   | 11 | 21 | 31 | 61 | 71 | 61 | 71 | 81 | 91 | A1 | B1 | E1 | F1 | E1 | F1 |
| 2                 | 02                   | 12 | 22 | 32 | 62 | 72 | 62 | 72 | 82 | 92 | A2 | B2 | E2 | F2 | E2 | F2 |
| 3                 | 03                   | 13 | 23 | 33 | 63 | 73 | 63 | 73 | 83 | 93 | A3 | B3 | E3 | F3 | E3 | F3 |
| 4                 | 04                   | 14 | 24 | 34 | 64 | 74 | 64 | 74 | 84 | 94 | A4 | B4 | E4 | F4 | E4 | F4 |
| 5                 | 05                   | 15 | 25 | 35 | 65 | 75 | 65 | 75 | 85 | 95 | A5 | B5 | E5 | F5 | E5 | F5 |
| 6                 | 06                   | 16 | 26 | 36 | 66 | 76 | 66 | 76 | 86 | 96 | A6 | B6 | E6 | F6 | E6 | F6 |
| 7                 | 07                   | 17 | 27 | 37 | 67 | 77 | 67 | 77 | 87 | 97 | A7 | B7 | E7 | F7 | E7 | F7 |
| 8                 | 08                   | 18 | 28 | 38 | 68 | 78 | 68 | 78 | 88 | 98 | A8 | B8 | E8 | F8 | E8 | F8 |
| 9                 | 09                   | 19 | 29 | 39 | 69 | 79 | 69 | 79 | 89 | 99 | A9 | B9 | E9 | F9 | E9 | F9 |
| A                 | 0A                   | 1A | 2A | 3A | 6A | 7A | 6A | 7A | 8A | 9A | AA | BA | EA | FA | EA | FA |
| B                 | 0B                   | 1B | 2B | 3B | 6B | 7B | 6B | 7B | 8B | 9B | AB | BB | EB | FB | EB | FB |
| C                 | 0C                   | 1C | 2C | 3C | 6C | 7C | 6C | 7C | 8C | 9C | AC | BC | EC | FC | EC | FC |
| D                 | 0D                   | 1D | 2D | 3D | 6D | 7D | 6D | 7D | 8D | 9D | AD | BD | ED | FD | ED | FD |
| E                 | 0E                   | 1E | 2E | 3E | 6E | 7E | 6E | 7E | 8E | 9E | AE | BE | EE | FE | EE | FE |
| F                 | 0F                   | 1F | 2F | 3F | 6F | 7F | 6F | 7F | 8F | 9F | AF | BF | EF | FF | EF | FF |

ZK-6417-GE

**Condition Values Returned**

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Routine successfully completed; string truncated. The destination string could not contain all the characters. |
| LIB\$_FATERRLIB | Fatal internal error.  |
| LIB\$_INSVIRMEM | Insufficient virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor.   |

**Example**

```

1  !+
   !This BASIC program shows the method
   !of creating a descriptor for the appropriate
   !translation table in order to call LIB$MOVTC.
   !-
   OPTION TYPE = EXPLICIT

```

## LIB\$ Routines LIB\$MOVTC

```
!+
!Declare the translation table as an
!EXTERNAL LONG variable.
!-

EXTERNAL LONG LIB$AB_ASC_EBC
EXTERNAL LONG FUNCTION LIB$MOVTC
EXTERNAL SUB LIB$STOP
EXTERNAL LONG CONSTANT DSC$K_CLASS_S, DSC$K_DTYPE_T

!+
!Define a record which models the required
!translation table descriptor.
!-

RECORD STR_TYPE
    WORD    DSC$W_LENGTH
    BYTE    DSC$B_DTYPE
    BYTE    DSC$B_CLASS
    LONG    DSC$A_POINTER
END RECORD STR_TYPE

DECLARE LONG I, RET_STS
DECLARE STR_TYPE STR_VAR

MAP (FOO) STRING DST = 3%
MAP (FOO) BYTE DST_ARRAY(2)

!+
!Fill the translation table descriptor record.
!Note that the length of the translation table string
!is set to 256, and the pointer receives the address of
!the Digital translation table LIB$AB_ASC_EBC.
!-

STR_VAR::DSC$W_LENGTH = 256
STR_VAR::DSC$B_DTYPE = DSC$K_DTYPE_T
STR_VAR::DSC$B_CLASS = DSC$K_CLASS_S
STR_VAR::DSC$A_POINTER = LOC(LIB$AB_ASC_EBC)

RET_STS = LIB$MOVTC( "ABC", " ", STR_VAR BY REF, DST )
IF (RET_STS AND 1%) = 0%
THEN
    CALL LIB$STOP( RET_STS BY VALUE )
END IF

!+
!Add 256 to the translated value in order to return
!an unsigned value.
!-

PRINT (256 + DST_ARRAY(I)) FOR I = 0% TO 2%

END
```

The output generated by this BASIC program is as follows:

```
193
194
195
```

---

## LIB\$MOVTUC

### Move Translated Until Character

The Move Translated Until Character routine moves the source string, character by character, to the destination string after translating each character using the specified translation table until the stop character is encountered. LIB\$MOVTUC makes the VAX MOVTUC instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$MOVTUC source-string ,stop-character ,translation-table ,destination-string [,fill-character]

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

The relative position in the source string of the character that is translated to the stop character. Zero is returned if the stop character is not found. This value is set to -1 if **destination-string** cannot be allocated.

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string to be translated and moved by LIB\$MOVTUC. The **source-string** argument is the address of a descriptor pointing to this source string.

##### stop-character

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Stop character that causes LIB\$MOVTUC to stop translating the source string. The **stop-character** argument is the address of a descriptor pointing to a string. The first character of this string is used as the stop character. The length of this string is not checked. During the translation, LIB\$MOVTUC accesses each character in the source string and uses it as an index into the translation table. If this translated character is the specified stop character, then translation stops and **stop-character** is not translated.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$ Routines

### LIB\$MOVTC

#### translation-table

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Translation table used by LIB\$MOVTC. The **translation-table** argument is the address of a descriptor pointing to the translation table string. The translation table string is assumed to be 256 characters long.

You can use any of the translation tables included in the Description section of LIB\$MOVTC, or you can create your own. When using a translation table supplied by Digital, the names LIB\$AB\_xxx\_yyy represent the addresses of the 256-byte translation tables, and can be accessed as external (string) variables. If a particular language cannot generate descriptors for external strings, then they must be created manually. The example for the routine LIB\$MOVTC shows the creation of a string descriptor for a translation table using VAX BASIC.

#### destination-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string into which LIB\$MOVTC writes the translated **source-string**. The **destination-string** argument is the address of a descriptor pointing to this destination string.

#### fill-character

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Character used to pad **source-string** to the length of **destination-string**. The **fill-character** argument is the address of a descriptor pointing to a string. The first character of this string is used as the fill character. The length of this string is not checked and **fill-character** is not translated.

If the fill character is included, the remainder of the destination string (after the stop character) is filled with the specified fill character. If it is not included, the remainder of the destination string remains unchanged.

## Description

During the translation, LIB\$MOVTC accesses each character in the source string and uses it as an index into the translation table. If the table entry contains the specified stop character, the routine is terminated and the relative position of the source character is returned.

If the source string is longer than the destination string, then the source string is truncated. If the optional fill character is present, any remaining positions in the destination string are filled with the fill character. If the source or destination string is exhausted (before the stop character is found), a zero index is returned.

The results are unpredictable if the source and destination strings overlap and have different starting addresses.

See the description of LIB\$MOVTC for the translation tables used by LIB\$MOVTC and LIB\$MOVTUC. Each translation table is preceded by explanatory text.

**Condition Values Returned**

None.

---

## LIB\$MULTF\_DELTA\_TIME

### Multiply Delta Time by an F-Floating Scalar

The Multiply Delta Time by an F-Floating Scalar routine multiplies a delta time by an F-floating scalar.

#### Format

LIB\$MULTF\_DELTA\_TIME multiplier ,delta-time

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### multiplier

OpenVMS usage: floating\_point  
type: F\_floating  
access: read only  
mechanism: by reference

The value by which LIB\$MULTF\_DELTA\_TIME multiplies the delta time. The **multiplier** argument is the address of an F-floating value containing the scalar. If **multiplier** is negative, the absolute value of **multiplier** is used.

##### delta-time

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: modify  
mechanism: by reference

The delta time to be multiplied. The **delta-time** argument is the address of an unsigned quadword containing the number to be multiplied. The **delta-time** argument must be less than 10,000 days. After LIB\$MULTF\_DELTA\_TIME performs the multiplication, the result is returned to **delta-time**. (The original **delta-time** value is overwritten.)

#### Description

LIB\$MULTF\_DELTA\_TIME multiplies a delta time by an F-floating scalar. The result of the multiplication is returned to the **delta-time** argument.

#### Condition Values Returned

|                |                                 |
|----------------|---------------------------------|
| LIB\$NORMAL    | Routine successfully completed. |
| LIB\$IVTIME    | Invalid time.                   |
| LIB\$WRONUMARG | Incorrect number of arguments.  |

---

## LIB\$MULT\_DELTA\_TIME

### Multiply Delta Time by Scalar

The Multiply Delta Time by Scalar routine multiplies a delta time by a longword integer scalar.

#### Format

LIB\$MULT\_DELTA\_TIME multiplier ,delta-time

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Arguments

**multiplier**  
 OpenVMS usage: longword\_signed  
 type: longword (signed)  
 access: read only  
 mechanism: by reference

The value by which LIB\$MULT\_DELTA\_TIME multiplies the delta time. The **multiplier** argument is the address of a signed longword containing the integer scalar. If **multiplier** is negative, the absolute value of **multiplier** is used.

**delta-time**  
 OpenVMS usage: date\_time  
 type: quadword (unsigned)  
 access: modify  
 mechanism: by reference

The delta time to be multiplied. The **delta-time** argument is the address of an unsigned quadword containing the number to be multiplied. the **delta-time** argument must be less than 10,000 days. After LIB\$MULT\_DELTA\_TIME performs the multiplication, the result is returned to **delta-time**. (The original **delta-time** value is overwritten.)

#### Description

LIB\$MULT\_DELTA\_TIME multiplies a delta time by a longword integer scalar. The result of the multiplication is returned to the **delta-time** argument.

#### Condition Values Returned

|                  |                                 |
|------------------|---------------------------------|
| LIB\$ _NORMAL    | Routine successfully completed. |
| LIB\$ _IVTIME    | Invalid time.                   |
| LIB\$ _WRONUMARG | Incorrect number of arguments.  |

## LIB\$ Routines

### LIB\$PARSE\_ACCESS\_CODE (VAX Only)

---

## LIB\$PARSE\_ACCESS\_CODE (VAX Only)

### Parse Access Encoded Name String

The Parse Access Encoded Name String routine parses and translates a string of access names into a mask for a particular ownership category.

#### Format

LIB\$PARSE\_ACCESS\_CODE access-string, [access-names,] ownership-category, access-mask,  
[end-position]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **access-string**

OpenVMS usage: char\_string  
type: character-coded text string  
access: read only  
mechanism: by descriptor

The **access-string** argument is the address of a character-string descriptor pointing to a string of access names. Each access name is abbreviated to one letter. An example of a valid access string is RWE. Access names are specific to each of the different object classes. See the *OpenVMS Guide to System Security* for a complete list of all valid access names.

##### **access-names**

OpenVMS usage: access\_names  
type: array [0..31] of quadword string descriptor  
access: read only  
mechanism: by reference

The **access-names** argument is the address of the access name table for the associated object class. For example, it is the value returned by the LIB\$GET\_ACCNAM routine in the **accnam** longword. This parameter is optional and defaults to the access name table for the FILE object class.

##### **ownership-category**

OpenVMS usage: mask\_word  
type: word (unsigned)  
access: read only  
mechanism: by reference

The **ownership-category** argument is the address of a word that indicates the ownership category the access names refer to:

**LIB\$ Routines**  
**LIB\$PARSE\_ACCESS\_CODE (VAX Only)**

| Ownership Category | Mask Value       |
|--------------------|------------------|
| System             | 0000000000001111 |
| Owner              | 0000000011110000 |
| Group              | 0000111100000000 |
| World              | 1111000000000000 |

**access-mask**

OpenVMS usage: mask\_word  
type: word (unsigned)  
access: write only  
mechanism: by reference

The **access-mask** argument is the address of a word into which this routine writes the access mask. In this mask, a set bit means the access was requested for the specified ownership. Note that this is the opposite of the standard protection format where a set bit means no access.

**end-position**

OpenVMS usage: word\_signed  
type: word (signed)  
access: write only  
mechanism: by reference

The **end-position** argument is the number of characters from **access-string** processed by LIB\$PARSE\_ACCESS\_CODE. In the case of an error in parsing the access string, the offset to the offending location is returned.

## Description

LIB\$PARSE\_ACCESS\_CODE parses a string of access names and translates the string into a mask for the requested ownership category. The string is a concatenated list of 1-letter abbreviations of access names.

This routine works for any protected object class by specifying the correct access name table. The address of the access name table can be obtained from the LIB\$GET\_ACCNAM routine.

This routine is useful for building a protection mask where the ownership names have already been parsed. Use LIB\$PARSE\_SOGW\_PROT for parsing a string containing both ownership and access names.

The mask returned has bits set for the access requested for the specified ownership category. This is opposite the standard protection format where a set bit in the protection mask means no access.

The number of characters processed is optionally returned. This is useful for error processing. The end position will be the offset to the character that made the access category name string invalid.

**LIB\$ Routines**  
**LIB\$PARSE\_ACCESS\_CODE (VAX Only)**

**Condition Values Returned**

|                    |  |
|--------------------|--|
| SS\$ _NORMAL       | Routine successfully completed.  |
| LIB\$ _IVARG       | Required parameter missing or a character in <b>access-string</b> did not represent a valid access type. |
| LIB\$ _WRONGNUMARG | Wrong number of arguments.   |

---

## LIB\$PARSE\_SOGW\_PROT (VAX Only)

### Parse Protection String

The Parse Protection String routine parses and translates a protection string into a protection mask.

#### Format

LIB\$PARSE\_SOGW\_PROT protection-string, [access-names], protection-mask, ownership-mask, [end-position]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### protection-string

OpenVMS usage: char\_string  
type: character-coded text string  
access: read only  
mechanism: by descriptor

The **protection-string** argument is the address of a character-string descriptor pointing to the protection string. The string components are:

- Ownership name — System,Owner,Group,World. Ownership names can be specified in full or truncated to any number of characters. Matching is case blind, and spacing is ignored.
- Access name — Access names are always abbreviated to one letter. For example, access names for files are R (for read), W (for write), E (for execute), and D (for delete). Any combination can be passed. For example, RWE is a valid combination. A null access name specification means no access.
- Separators — Access names are separated from ownership names by either a colon (:) or an equals sign (=). The comma (,) is the list separator. A null access name specification means no access.

An example of a valid protection string is:

SYSTEM=RWED,OWNER:RWED,GROUP,WORLD:R

##### access-names

OpenVMS usage: access\_names  
type: array [0..31] of quadword string descriptor  
access: read only  
mechanism: by reference

The **access-names** argument is the address of the access name table for the associated object class. For example, it is the value returned by the LIB\$GET\_ACCNAM routine in the **accnam** longword. This parameter is optional and defaults to the access name table for the FILE object class.

## LIB\$ Routines

### LIB\$PARSE\_SOGW\_PROT (VAX Only)

#### protection-mask

OpenVMS usage: protection  
type: word (unsigned)  
access: write only  
mechanism: by reference

The **protection-mask** argument is the address of a word into which this routine writes a 16-bit protection mask translation of the protection string. Each bit set in the mask indicates no access for the access type it represents.

#### ownership-mask

OpenVMS usage: mask\_word  
type: word (unsigned)  
access: write only  
mechanism: by reference

The **ownership-mask** argument is the address of a word that indicates which ownership names were present in the protection string.

| Ownership Category | Mask Value       |
|--------------------|------------------|
| System             | 0000000000001111 |
| Owner              | 0000000011110000 |
| Group              | 0000111100000000 |
| World              | 1111000000000000 |

#### end-position

OpenVMS usage: word\_signed  
type: word (signed)  
access: write only  
mechanism: by reference

The **end-position** argument is the number of characters from **protection-string** processed by LIB\$PARSE\_SOGW\_PROT. In the case of an error in parsing the protection string, the offset to the offending location is returned.

## Description

LIB\$PARSE\_SOGW\_PROT parses a protection string and translates the string into a 16-bit protection mask. LIB\$PARSE\_SOGW\_PROT works for any protected object class by specifying the correct access name table.

The address of the access name table can be obtained from the LIB\$GET\_ACCNAM routine. Note that file access names are valid for any protected object class.

The number of characters processed is optionally returned. This is useful in error processing. The end position will be the offset to the character that made the protection string invalid. Note that the entire protection string must be valid, or an error is returned.

Several scenarios can cause the protection string to be invalid. The format of the protection string may be invalid, or the access category abbreviations may not be valid with respect to the access name tables.

**Condition Values Returned**

|                   |  |
|-------------------|--|
| SS\$_NORMAL       | Routine successfully completed.                          |
| LIB\$_IVARG       | Required parameter missing or invalid protection string. |
| LIB\$_WRONGNUMARG | Wrong number of arguments.                               |

## **LIB\$PAUSE**

### **Pause Program Execution**

The Pause Program Execution routine suspends program execution and returns control to the calling command level.

#### **Format**

LIB\$PAUSE

#### **Returns**

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### **Arguments**

None.

#### **Description**

LIB\$PAUSE suspends program execution and returns control to the calling command level. The suspended image may be continued with the CONTINUE command, or it may be terminated with the EXIT or STOP command. In the latter case, the image will not return to this routine.

Note that this routine functions only for interactive jobs. If this routine is invoked in batch mode, it has no effect.

#### **Condition Values Returned**

|             |   |
|-------------|---|
| SS\$_NORMAL | Routine successfully completed.   |
| LIB\$_NOCLI | No CLI present. The calling process does not have a CLI or the CLI does not support the request. Note that DCL supports this function in INTERACTIVE mode only. |

---

## LIB\$POLYD

### Evaluate Polynomials

The Evaluate Polynomials routine (D-floating values) allows higher level language users to evaluate D-floating value polynomials.

#### Alpha

D-floating values are not supported in full precision in native OpenVMS Alpha programs. They are precise to 56 bits on VAX systems, 53 or 56 bits in translated VAX images, and 53 bits in native OpenVMS Alpha programs. ♦

#### Format

LIB\$POLYD polynomial-argument ,degree ,coefficient ,floating-point-result

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### polynomial-argument

OpenVMS usage: floating\_point  
type: D\_floating  
access: read only  
mechanism: by reference

Argument for the polynomial. The **polynomial-argument** argument is the address of a floating-point number that contains this argument. The **polynomial-argument** argument is a D-floating number.

##### degree

OpenVMS usage: word\_signed  
type: word integer (signed)  
access: read only  
mechanism: by reference

Highest numbered nonzero coefficient to participate in the evaluation. The **degree** argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

##### coefficient

OpenVMS usage: floating\_point  
type: D\_floating  
access: read only  
mechanism: by reference, array reference

Floating-point coefficients. The **coefficient** argument is the address of an array of floating-point coefficients. The coefficient of the highest order term of the polynomial is the lowest addressed element in the array. The **coefficient** argument is an array of D-floating numbers.

## LIB\$ Routines

### LIB\$POLYD

#### floating-point-result

OpenVMS usage: floating\_point  
type: D\_floating  
access: write only  
mechanism: by reference

Result of the calculation. The **floating-point-result** argument is the address of a floating-point number that contains this result. LIB\$POLYD writes the address of **floating-point-result** into a D-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (63 bits for POLYD).

### Description

LIB\$POLYD provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

$$\text{result} = C[0] + X * (C[1] + X * (C[2] + \dots X * (C[D]) \dots))$$

In the above result  $D$  is the degree of the polynomial and  $X$  is the argument.

See the *VAX Architecture Reference Manual* for the detailed description of POLY.

### Condition Values Returned

|              |                                 |
|--------------|---------------------------------|
| SS\$_NORMAL  | Routine successfully completed. |
| SS\$_FLTQVF  | Floating overflow.              |
| SS\$_ROPRAND | Reserved operand.               |

### Example

The Fortran and Pascal examples provided in the description of LIB\$POLYF also demonstrate how to use LIB\$POLYD. Please refer to those examples for assistance in using this routine.

---

## LIB\$POLYF

### Evaluate Polynomials

The Evaluate Polynomials routine (F-floating values) allows higher level language users to evaluate F-floating polynomials.

#### Format

LIB\$POLYF polynomial-argument ,degree ,coefficient ,floating-point-result

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### polynomial-argument

OpenVMS usage: floating\_point  
type: F\_floating  
access: read only  
mechanism: by reference

Argument for the polynomial. The **polynomial-argument** argument is the address of a floating-point number that contains this argument. The **polynomial-argument** argument is an F-floating number.

##### degree

OpenVMS usage: word\_signed  
type: word (signed)  
access: read only  
mechanism: by reference

Highest numbered nonzero coefficient to participate in the evaluation. The **degree** argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

##### coefficient

OpenVMS usage: floating\_point  
type: F\_floating  
access: read only  
mechanism: by reference, array reference

Floating-point coefficients. The **coefficient** argument is the address of an array of floating-point coefficients. The coefficient of the highest order term of the polynomial is the lowest addressed element in the array. The **coefficient** argument is an array of F-floating numbers.

## LIB\$ Routines

### LIB\$POLYF

#### floating-point-result

OpenVMS usage: floating\_point  
type: F\_floating  
access: write only  
mechanism: by reference

Result of the calculation. The **floating-point-result** argument is the address of a floating-point number that contains this result. LIB\$POLYF writes the address of **floating-point-result** into an F-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (31 bits for POLYF).

#### Description

LIB\$POLYF provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

$$\text{result} = C[0] + X * (C[1] + X * (C[2] + \dots + X * (C[D]) \dots))$$

In the above result  $D$  is the degree of the polynomial and  $X$  is the argument.

#### Condition Values Returned

|              |                                 |
|--------------|---------------------------------|
| SS\$_NORMAL  | Routine successfully completed. |
| SS\$_FLTOVF  | Floating overflow.              |
| SS\$_ROPRAND | Reserved operand.               |

#### Examples

```
1. C+
   C This Fortran example demonstrates how to use
   C LIB$POLYF.
   C-

      REAL*4 X,COEFF(5),RESULT
      INTEGER*2 DEG

   C+
   C Compute X^4 + 2*X^3 -X^2 + X - 3 using POLYF.
   C Let X = 2.
   C The coefficients needed are as follows:
   C-

      DATA COEFF/1.0,2.0,-1.0,1.0,-3.0/
      X = 2.0
      DEG = 4                                ! DEG has word length.

   C+
   C Calculate (2)^4 + 2*(2^3) -2^2 + 2 - 3.
   C The result should be 27.
   C-

      RETURN = LIB$POLYF(X,DEG,COEFF,RESULT)
      TYPE *, '(2)^4 + 2*(2^3) -2^2 + 2 - 3 = ', RESULT
      END
```

This Fortran example demonstrates how to call LIB\$POLYF. The output generated by this program is as follows:

$$(2)^4 + 2*(2^3) - 2^2 + 2 - 3 = 27.00000$$

```

2. PROGRAM POLYF(INPUT,OUTPUT);
{+}
{ This Pascal program demonstrates how to use
{ LIB$POLYF to evaluate a polynomial.
{-}

    TYPE
        WORD = [WORD] 0..65535;

    VAR
        COEFF : ARRAY [0..2] OF REAL := (1.0,2.0,2.0);
        RESULT : REAL;
        RETURNED_STATUS : INTEGER;

    [EXTERNAL] FUNCTION LIB$POLYF(
        ARG      : REAL;
        DEGREE   : WORD;
        COEFF    : [REFERENCE] ARRAY [L..U:INTEGER] OF REAL;
        VAR RESULT : REAL
        ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$STOP(
        CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
        FAO_ARGS         : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
        ) : INTEGER; EXTERNAL;

BEGIN
{+}
{ Call LIB$POLYF to evaluate 2(X**2) + 2*X + 1.
{-}

RETURNED_STATUS := LIB$POLYF(1.0,2,COEFF,RESULT);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

WRITELN('F(1.0) = ',RESULT:5:2);

END.

```

This example program demonstrates how to call LIB\$POLYF from Pascal.  
The output generated by this Pascal program is as follows:

```

$ RUN POLYF
F(1.0) = 5.00

```

## LIB\$POLYG Evaluate Polynomials

The Evaluate Polynomials routine (G-floating values) allows higher level language users to evaluate G-floating value polynomials.

### Format

LIB\$POLYG polynomial-argument ,degree ,coefficient ,floating-point-result

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### polynomial-argument

OpenVMS usage: floating\_point  
type: G\_floating  
access: read only  
mechanism: by reference

Argument for the polynomial. The **polynomial-argument** argument is the address of a floating-point number that contains this argument. The **polynomial-argument** argument is a G-floating number.

#### degree

OpenVMS usage: word\_signed  
type: word integer (signed)  
access: read only  
mechanism: by reference

Highest numbered nonzero coefficient to participate in the evaluation. The **degree** argument is the address of a signed word integer that contains this highest-numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

#### coefficient

OpenVMS usage: floating\_point  
type: G\_floating  
access: read only  
mechanism: by reference, array reference

Floating-point coefficients. The **coefficient** argument is the address of an array of floating-point coefficients. The coefficient of the highest order term of the polynomial is the lowest addressed element in the array. The **coefficient** argument is an array of G-floating numbers.

**floating-point-result**

OpenVMS usage: floating\_point  
 type: G\_floating  
 access: write only  
 mechanism: by reference

Result of the calculation. The **floating-point-result** argument is the address of a floating-point number that contains this result. LIB\$POLYG writes the address of **floating-point-result** into a G-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (63 bits for POLYG).

**Description**

LIB\$POLYG provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

$$\text{result} = C[0] + X * (C[1] + X * (C[2] + \dots + X * (C[D]) \dots))$$

In the above result *D* is the degree of the polynomial and *X* is the argument.

**Condition Values Returned**

|              |                                 |
|--------------|---------------------------------|
| SS\$_NORMAL  | Routine successfully completed. |
| SS\$_FLTOVF  | Floating overflow.              |
| SS\$_ROPRAND | Reserved operand.               |

**Example**

The Fortran and Pascal examples provided in the description of LIB\$POLYF also demonstrate how to use LIB\$POLYG. Please refer to those examples for assistance in using this routine.

## LIB\$POLYH Evaluate Polynomials

On OpenVMS VAX systems, the Evaluate Polynomials routine (H-floating values) allows higher-level language users to evaluate H-floating value polynomials.

**Alpha**

This routine is not available to native OpenVMS Alpha programs but is available to translated VAX images. ♦

### Format

LIB\$POLYH polynomial-argument ,degree ,coefficient ,floating-point-result

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### polynomial-argument

OpenVMS usage: floating\_point  
type: H\_floating  
access: read only  
mechanism: by reference

Argument for the polynomial. The **polynomial-argument** argument is the address of a floating-point number that contains this argument. The **polynomial-argument** argument is an H-floating number.

#### degree

OpenVMS usage: word\_signed  
type: word integer (signed)  
access: read only  
mechanism: by reference

Highest numbered nonzero coefficient to participate in the evaluation. The **degree** argument is the address of a signed word integer that contains this highest numbered coefficient.

If the degree is 0, the result equals C[0]. The range of the degree is 0 to 31.

#### coefficient

OpenVMS usage: floating\_point  
type: H\_floating  
access: read only  
mechanism: by reference, array reference

Floating-point coefficients. The **coefficient** argument is the address of an array of floating-point coefficients. The coefficient of the highest order term of the polynomial is the lowest addressed element in the array. The **coefficient** argument is an array of H-floating numbers.

**floating-point-result**

OpenVMS usage: floating\_point  
 type: H\_floating  
 access: write only  
 mechanism: by reference

Result of the calculation. The **floating-point-result** argument is the address of a floating-point number that contains this result. LIB\$POLYH writes the address of **floating-point-result** into an H-floating number.

Intermediate multiplications are carried out using extended floating-point fractions (127 bits for POLYH).

**Description**

LIB\$POLYH provides higher-level language users with the capability of evaluating polynomials.

The evaluation is carried out by Horner's Method. The result is computed as follows:

result = C[0]+X\*(C[1]+X\*(C[2]+...X\*(C[D])...))

In the above result *D* is the degree of the polynomial and *X* is the argument.

**Condition Values Returned**

|              |                                 |
|--------------|---------------------------------|
| SS\$_NORMAL  | Routine successfully completed. |
| SS\$_FLTOVF  | Floating overflow.              |
| SS\$_ROPRAND | Reserved operand.               |

**Example**

The Fortran and Pascal examples provided in the description of LIB\$POLYF also demonstrate how to use LIB\$POLYH. Please refer to those examples for assistance in using this routine.

## LIB\$PUT\_COMMON

### Put String to Common

The Put String to Common routine copies the contents of a string into the common area. The common area is an area of storage which remains defined across multiple image activations in a process. Optionally, LIB\$PUT\_COMMON returns the actual number of characters copied. The maximum number of characters that can be copied is 252.

#### Format

LIB\$PUT\_COMMON source-string [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string to be copied to the common area by LIB\$PUT\_COMMON. The **source-string** argument is the address of a descriptor pointing to this source string.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of characters copied by LIB\$PUT\_COMMON to the common area. The **resultant-length** argument is the address of an unsigned word integer that contains this number of characters. LIB\$PUT\_COMMON writes this number into the **resultant-length** argument.

#### Description

LIB\$PUT\_COMMON and LIB\$GET\_COMMON allow programs to copy strings to and from the common area. The programs reading and writing the data in the common area must agree upon its amount and format. The maximum length of the destination string is defined as follows:

[min(256, the length of the data in the common storage area) - 4]

Thus, the maximum length is 252.

## LIB\$ Routines LIB\$PUT\_COMMON

In BASIC and Fortran, you can use these routines to allow a USEROPEN routine to pass information back to the routine that called it. A USEROPEN routine cannot write arguments. However, it can call LIB\$PUT\_COMMON to put information into the common area. The calling program can then use LIB\$GET\_COMMON to retrieve it.

You can also use these routines to pass information between images run successively, such as chained images run by LIB\$RUN\_PROGRAM. Since the common area is unique to each process, do not use LIB\$GET\_COMMON and LIB\$PUT\_COMMON to share information across processes.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Successfully completed, but the source string was truncated.   |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |

## LIB\$ Routines

### LIB\$PUT\_INVO\_REGISTERS (Alpha Only)

---

## LIB\$PUT\_INVO\_REGISTERS (Alpha Only)

### Put Invocation Registers

The Put Invocation Registers routine modifies specified values in a procedure's invocation context. A procedure's invocation context consists of the values stored in the integer and floating-point registers as well as the program counter and the processor status registers.

LIB\$PUT\_INVO\_REGISTERS updates internal register save areas with the new values. These values are written to the active register set by the time control returns to the procedure associated with the specified invocation handle.

#### Format

LIB\$PUT\_INVO\_REGISTERS    invo\_handle, invo\_context, invo\_mask

#### Returns

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by value

Status value. A value of 1 indicates success. When the initial context represents the bottom of the call chain, a value of 0 is returned.

#### Arguments

##### **invo\_handle**

OpenVMS usage: invo\_handle  
type: longword (unsigned)  
access: read only  
mechanism: by value

Handle for the invocation to be updated.

##### **invo\_context**

OpenVMS usage: invo\_context\_blk  
type: structure  
access: read only  
mechanism: by reference

Address of an invocation context block that contains the values to be written to the registers.

Each register that is set in the **invo\_mask** parameter is updated using the value found in the corresponding IREG or FREG field of the invocation context block. The program counter and processor status of the given invocation can also be updated in this way. No other fields of the invocation context block are used.

## LIB\$ Routines LIB\$PUT\_INVO\_REGISTERS (Alpha Only)

### invo\_mask

OpenVMS usage: mask\_quadword  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Address of a 64-bit vector, where each bit corresponds to a register field in the passed **invo\_context**. Bits 0 through 30 correspond to IREG[0] through IREG[30], bit 31 corresponds to PROGRAM\_COUNTER, bits 32 through 62 correspond to FREG[0] through FREG[30], and bit 63 corresponds to PROCESSOR\_STATUS.

### Description

LIB\$PUT\_INVO\_REGISTERS updates a given procedure invocation context's fields with new register contents.

---

#### Note

---

Only the conventional saved registers (R2 through R15) can be modified reliably in this way. Any modification to scratch registers may be overwritten by code in intervening procedure invocations. Any attempt to modify control registers (R29 and R30) may result in unpredictable program behavior.

Therefore, an action such as reading the context of a given procedure invocation and then updating that context in its entirety may not produce the desired results, whether or not you have made any modifications.

When using this routine, the caller should plan carefully and should explicitly modify only those register values that need to be modified.

---

See the *OpenVMS Calling Standard* manual for additional information.

### Condition Values Returned

None.

---

## LIB\$PUT\_OUTPUT

### Put Line to SYS\$OUTPUT

The Put Line to SYS\$OUTPUT routine writes a record to the current controlling output device, specified by SYS\$OUTPUT using the RMS \$PUT service.

#### Format

LIB\$PUT\_OUTPUT message-string

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

##### message-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Message string written to the current controlling output device by LIB\$PUT\_OUTPUT. The **message-string** argument is the address of a descriptor pointing to this message string. RMS handles all formatting, so the message does not need to include such ASCII formatting instructions as carriage return (CR).

#### Description

When you log in, OpenVMS operating systems create three files as default I/O control streams for your process:

- SYS\$INPUT, your default input device
- SYS\$OUTPUT, your default output device
- SYS\$COMMAND, the device that supplies the commands to your process

These files remain open until you log out. They are the interface between your interactive input and output or batch commands and the OpenVMS software. Initially, all three are equated with the terminal. However, with the DCL ASSIGN command, you can change these assignments to obtain information from a file or put information into a file. SYS\$INPUT and SYS\$COMMAND are usually identical, but the input and command streams can be different. For example, during the execution of an indirect command file from an interactive terminal, SYS\$COMMAND refers to the terminal and SYS\$INPUT refers to the command file.

On the first call to LIB\$PUT\_OUTPUT, if the output file is not a process-permanent file, LIB\$PUT\_OUTPUT opens the output file and positions it at the end-of-file mark. If no output file exists on the first call, LIB\$PUT\_OUTPUT creates a file. The RMS internal stream identifier (ISI) is stored in the routine's static storage for subsequent calls. Hence, this routine is not AST reentrant.

LIB\$PUT\_OUTPUT uses RMS to format records on output, and RMS records have implied carriage control. That is, a record normally corresponds to a line of text. Therefore, if you want explicit carriage control, instead of implied carriage control, you must supply it yourself within the source string.

LIB\$PUT\_OUTPUT is the most convenient way for a MACRO or BLISS program to write information to SYS\$OUTPUT.

If you have several shareable images that call LIB\$PUT\_OUTPUT, and if each shareable image includes its own copy of LIB\$PUT\_OUTPUT, your program could produce multiple output streams and multiple versions of your output file. A single application should reference one copy of LIB\$PUT\_OUTPUT.

### Condition Values Returned

SS\$\_NORMAL                      Routine successfully completed.

Any condition values returned by RMS.

### Example

```
10      !+
        ! This BASIC program demonstrates how to use
        ! LIB$PUT_OUTPUT to output a simple message.
        !-

        MSGSTR$ = 'This is a sample message'
        CALL LIB$PUT_OUTPUT(MSGSTR$)

        !+
        ! In this example, the default value of
        ! SYS$OUTPUT is used. Therefore, the
        ! output is 'put' to the terminal screen.
        !-

90      END
```

This BASIC program shows the use of LIB\$PUT\_OUTPUT. The output generated by this BASIC example is as follows:

```
    This is a sample message
```

## LIB\$RADIX\_POINT Radix Point Symbol

The Radix Point Symbol routine returns the system's radix point symbol. This symbol is used inside a digit string to separate the integer part from the fraction part. This routine works by attempting to translate the logical name SYS\$RADIX\_POINT as a process, group, or system logical name.

### Format

LIB\$RADIX\_POINT radix-point-string [,resultant-length]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### radix-point-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Radix point string. The **radix-point-string** argument is the address of a descriptor pointing to this radix point string.

#### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

The number of characters written into **radix-point-string**, not counting padding in the case of a fixed-length string. The **resultant-length** argument is the address of an unsigned word that contains this number.

If the **radix-point-string** argument is the address of a fixed-length string descriptor, there may not be enough characters in the fixed-length string to contain the whole radix point string, and the radix point string is truncated. If the radix point string is truncated to the size specified in a fixed-length string descriptor, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **radix-point-string**.

## **Description**

If unable to translate the logical name `SYS$RADIX_POINT`, `LIB$RADIX_POINT` returns the United States radix point symbol (.). If the translation succeeds, the text produced is returned. Thus, a system manager can define `SYS$RADIX_POINT` as a system-wide logical name to provide a default for all users, and an individual user with a special need can define `SYS$RADIX_POINT` as a process logical name to override the default.

`LIB$RADIX_POINT` is used implicitly by BASIC.

## **Condition Values Returned**

|                             |   |
|-----------------------------|---|
| <code>SS\$NORMAL</code>     | Routine successfully completed.                                   |
| <code>LIB\$STRTRU</code>    | Successfully completed, but the radix point string was truncated. |
| <code>LIB\$FATERRLIB</code> | Fatal internal error.   |
| <code>LIB\$INSVIRMEM</code> | Insufficient virtual memory.                                      |
| <code>LIB\$INVSTRDES</code> | Invalid string descriptor.  |

---

## LIB\$REMQHI

### Remove Entry from Head of Queue

The Remove Entry from Head of Queue routine removes an entry from the head of the specified self-relative longword interlocked queue.† LIB\$REMQHI makes the REMQHI instruction available as a callable routine.

#### Format

LIB\$REMQHI header ,remque-address [,retry-count]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### header

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue from which **entry** will be removed. The **header** argument contains the address of this signed aligned quadword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

#### Alpha

On Alpha systems, the **header** argument must contain a 32-bit address. A 64-bit address results in an illegal operand exception. ♦

##### remque-address

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Address of the removed entry. The **remque-address** argument is the address of an unsigned longword that contains this address. If the queue was empty, **remque-address** is set to the address of the header.

#### Alpha

On Alpha systems, the **remque-address** argument must contain a 32-bit address. A 64-bit address results in an illegal operand exception. ♦

##### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of a longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

## **Description**

The queue from which LIB\$REMQHI removes an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

### **Self-Relative Queues**

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB\$INSQHI, LIB\$INSQTI, LIB\$REMQHI, and LIB\$REMQTI routines to manage your self-relative longword queue on a VAX or an Alpha system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

### **Synchronization**

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

### **Alignment**

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run-Time Library routine LIB\$GET\_VM on a VAX or an Alpha system to allocate quadword-aligned virtual memory for a queue.

## **Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue contains one or more entries. |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue is empty.                     |

**LIB\$ Routines**  
**LIB\$REMQHI**

LIB\$\_SECINTFAI

A secondary interlock failure occurred; the insertion was attempted the number of times specified by **retry-count**. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB\$\_QUEWASEMP  
SS\$\_ROPRAND

The queue was empty. The queue is not modified.  
Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.

---

## LIB\$REMQHIQ (Alpha Only) Remove Entry from Head of Queue

The Remove Entry from Head of Queue routine removes an entry from the head of the specified self-relative quadword interlocked queue. LIB\$REMQHIQ makes the REMQHIQ instruction available as a callable routine.

### Format

LIB\$REMQHIQ header ,remque-address [,retry-count]

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### header

OpenVMS usage: octaword\_signed  
type: octaword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue from which **entry** will be removed. The **header** argument contains the address of this signed aligned octaword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

#### remque-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Address of the removed entry. The **remque-address** argument is the address of an unsigned quadword that contains this address. If the queue was empty, **remque-address** is set to the address of the header.

#### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of a longword that contains the retry count value. A value of 1 causes no retries. The default value is 10.

## LIB\$ Routines

### LIB\$REMQHIQ (Alpha Only)

#### Description

The queue from which LIB\$REMQHIQ removes an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

#### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB\$INSQHIQ, LIB\$INSQTIQ, LIB\$REMQHIQ, and LIB\$REMQTIQ routines to manage your self-relative quadword queue on an Alpha system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

#### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

#### Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB\$GET\_VM\_64 to allocate octaword-aligned virtual memory for a queue.

#### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue contains one or more entries. |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was removed from the head of the queue, and the resulting queue is empty.                     |

**LIB\$ Routines**  
**LIB\$REMQHIQ (Alpha Only)**

LIB\$\_SECINTFAI

A secondary interlock failure occurred; the insertion was attempted the number of times specified by **retry-count**. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

LIB\$\_QUEWASEMP

The queue was empty. The queue is not modified.

SS\$\_ROPRAND

Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.

---

## LIB\$REMQTI

### Remove Entry from Tail of Queue

The Remove Entry from Tail of Queue routine removes an entry from the tail of the specified self-relative longword interlocked queue.† LIB\$REMQTI makes the REMQTI instruction available as a callable routine.

#### Format

LIB\$REMQTI header ,remque-address [,retry-count]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### header

OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue from which the entry is to be deleted. The **header** argument contains the address of this signed aligned quadword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

##### Alpha

On Alpha systems, the **header** argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address. ♦

##### remque-address

OpenVMS usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Address of the removed entry. The **remque-address** argument is the address of a longword that contains this address. If the queue was empty, **remque-address** is set to the address of the header.

##### Alpha

On Alpha systems, the **remque-address** argument must contain a 32-bit sign-extended address. An illegal operand exception occurs for any other form of address. ♦

##### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of a longword that is this retry count value. A value of 1 causes no retries. The default value is 10.

## Description

The queue from which LIB\$REMQTI removes an in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are longwords, the queue is referred to as a self-relative longword queue.

You can use the LIB\$INSQHI, LIB\$INSQTI, LIB\$REMQHI, and LIB\$REMQTI routines to manage your self-relative longword queue on a VAX or an Alpha system. These routines implement the INSQHI, INSQTI, REMQHI, and REMQTI instructions that allow you to insert and remove an entry at the head or tail of a self-relative longword queue.

### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

### Alignment

Use of the self-relative longword queue routines requires that the queue header and each of the queue entries be quadword aligned. You can use the Run-Time Library routine LIB\$GET\_VM on a VAX or an Alpha system to allocate quadword-aligned virtual memory for a queue.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed. The entry was removed from the queue tail, and the resulting queue contains one or more entries. |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was removed from the queue tail, and the resulting queue is empty.                     |
| LIB\$_QUEWASEMP | Queue was empty. The queue is not modified.  |

**LIB\$ Routines**  
**LIB\$REMQTI**

LIB\$\_SECINTFAI

A secondary interlock failure occurred; the insertion was attempted the number of times specified by **retry-count**. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

SS\$\_ROPRAND

Reserved operand fault. Either the entry or the header is at an address that is not quadword aligned, or the header address equals the entry address.

---

## LIB\$REMQTIQ (Alpha Only)

### Remove Entry from Tail of Queue

The Remove Entry from Tail of Queue routine removes an entry from the tail of the specified self-relative quadword interlocked queue. LIB\$REMQTIQ makes the REMQTIQ instruction available as a callable routine.

#### Format

LIB\$REMQTIQ header ,remque-address [,retry-count]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### header

OpenVMS usage: octaword\_signed  
type: octaword integer (signed)  
access: modify  
mechanism: by reference

Queue header specifying the queue from which the entry is to be deleted. The **header** argument contains the address of this signed aligned octaword integer. The **header** argument must be initialized to zero before first use of the queue; zero means an empty queue.

##### remque-address

OpenVMS usage: address  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Address of the removed entry. The **remque-address** argument is the address of a quadword that contains this address. If the queue was empty, **remque-address** is set to the address of the header.

##### retry-count

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

The number of times the operation is to be retried in case of secondary-interlock failure of the queue instruction in a processor-shared memory application. The **retry-count** argument is the address of a longword that is this retry count value. A value of 1 causes no retries. The default value is 10.

## LIB\$ Routines LIB\$REMQTIQ (Alpha Only)

### Description

The queue from which LIB\$REMQTIQ removes an entry can be in process-private, processor-private, or processor-shareable memory to implement per-process, per-processor, or across-processor queues.

#### Self-Relative Queues

A queue is a doubly linked list. A Run-Time Library routine specifies a queue entry by its address.

A self-relative queue is a queue in which the links between entries are the displacements of the current entry's predecessor and successor. If these links are quadwords, the queue is referred to as a self-relative quadword queue.

You can use the LIB\$INSQHIQ, LIB\$INSQTIQ, LIB\$REMQHIQ, and LIB\$REMQTIQ routines to manage your self-relative quadword queue on an Alpha system. These routines implement the INSQHIQ, INSQTIQ, REMQHIQ, and REMQTIQ instructions that allow you to insert and remove an entry at the head or tail of a self-relative quadword queue.

#### Synchronization

When you insert or remove a queue entry using the self-relative queue routines, the queue pointers are changed as an atomic operation. This ensures that no other process can interrupt the operation to insert or remove a queue entry of its own.

When you use these routines, cooperating processes can communicate without further synchronization and without danger of being interrupted, either on a single processor or in a multiprocessor environment. The queue access routines are also useful in an AST environment; they allow you to add or remove an entry from a queue without being interrupted by an AST.

If you do not use the self-relative queue routines to insert or remove a queue entry, you must ensure that the operation cannot be interrupted.

#### Alignment

Use of the self-relative quadword queue routines requires that the queue header and each of the queue entries be octaword aligned. You can use the Run-Time Library routine LIB\$GET\_VM\_64 to allocate octaword-aligned virtual memory for a queue.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed. The entry was removed from the queue tail, and the resulting queue contains one or more entries. |
| LIB\$_ONEENTQUE | Routine successfully completed. The entry was removed from the queue tail, and the resulting queue is empty.                     |
| LIB\$_QUEWASEMP | Queue was empty. The queue is not modified.  |

**LIB\$ Routines**  
**LIB\$REMOTIQ (Alpha Only)**

LIB\$\_SECINTFAI

A secondary interlock failure occurred; the insertion was attempted the number of times specified by **retry-count**. This is a severe error. The queue is not modified. This condition can occur only when the queue is in memory being shared between two or more processors.

SS\$\_ROPRAND

Reserved operand fault. Either the entry or the header is at an address that is not octaword aligned, or the header address equals the entry address.

## LIB\$RENAME\_FILE

### Rename One or More Files

The Rename One or More Files routine changes the names of one or more files. The specification of the files to be renamed can include wildcards.

LIB\$RENAME\_FILE is similar in function to the DCL command RENAME.

#### Format

```
LIB$RENAME_FILE old-filespec ,new-filespec [,default-filespec] [,related-filespec] [,flags]
                [,user-success-procedure] [,user-error-procedure] [,user-confirm-procedure]
                [,user-specified-argument] [,old-resultant-name] [,new-resultant-name]
                [,file-scan-context]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### old-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File specification of the files to be renamed. The **old-filespec** argument is the address of a descriptor pointing to the old file specification. The specification may include wildcards, in which case each file which matches the specification will be renamed. The string must not contain more than 255 characters. Any string class is supported.

##### new-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File specification for the new file names. The **new-filespec** argument is the address of a descriptor pointing to the new file specification.

This specification need not be complete; fields omitted or specified by using the wildcard character (\*) will be filled in from the existing file's name using the same rules as for the DCL command RENAME. The string must not contain more than 255 characters. Any string class is supported.

##### default-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Default file specification of the files to be renamed. The **default-filespec** argument is the address of a descriptor pointing to the default file specification.

This is an optional argument; if omitted, the default is the null string. See the *OpenVMS Record Management Services Reference Manual* for information on default file specifications. The string must not contain more than 255 characters. Any string class is supported.

#### **related-filespec**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Related file specification of the files to be renamed. The **related-filespec** argument is the address of a descriptor pointing to the related file specification. This is an optional argument; if omitted, the default is the null string. Any string class is supported.

Input file parsing is used. (See the *OpenVMS Record Management Services Reference Manual* for information on related file specifications and input file parsing.)

The related file specification is useful when you are processing lists of file specifications. Unspecified portions of the file specification are inherited from the last file processed. Any string class is supported. This is an optional argument.

#### **flags**

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Longword of flag bits designating optional behavior. The **flags** argument is the address of an unsigned longword containing the flag bits. This is an optional argument; if omitted, the default is that all flags are clear.

## LIB\$ Routines

### LIB\$RENAME\_FILE

The bit number and its meaning are as follows:

| Bit | Description   | Action if Set   | Action if Clear  |
|-----|---|---|--|
| 0   | If <b>new-filespec</b> does not specify a version number, this flag controls whether a new version number for the output file is to be assigned.  | The current version number of the file is used.   | The file is given a version number 1 higher than any previously existing file of the same file name and file type. This is the default action. |
|     | If a file already exists with the same file name, type and version number, the error RMS\$_FEX is given. This flag is equivalent to the /NONEW_VERSION qualifier of the DCL command RENAME. |   |  |
| 1   | Controls whether the renamed file takes on security attributes of the new location or keeps its existing security attributes.   | The attributes of the renamed file are inherited from the next lower version of the new file name, if any, the new parent directory, or both. | The file's security attributes are not changed; this is the default action.  |
|     | For more information on file security, see the <i>OpenVMS Guide to System Security</i> . This flag is equivalent to the /INHERIT_SECURITY qualifier of the DCL command RENAME.              |   |  |

#### user-success-procedure

OpenVMS usage: procedure  
 type: procedure value  
 access: function call (before return)  
 mechanism: by value

User-supplied success routine that LIB\$RENAME\_FILE calls after each successful rename.

For further information on the success routine, see Call Format for a Success Routine in the Description section.

#### user-error-procedure

OpenVMS usage: procedure  
 type: procedure value  
 access: function call (before return)  
 mechanism: by value

User-supplied error routine that LIB\$RENAME\_FILE calls when it detects an error. The value returned by the error routine determines whether LIB\$RENAME\_FILE processes more files. For further information on the error routine, see Call Format for an Error Routine in the Description section.

#### user-confirm-procedure

OpenVMS usage: procedure  
 type: procedure value  
 access: function call (before return)  
 mechanism: by value

User-supplied confirm routine that LIB\$RENAME\_FILE calls before it renames a file. The value returned by the confirm routine determines whether or not LIB\$RENAME\_FILE renames the file.

The confirm routine can be used to select specific files for renaming based on criteria such as expiration date, size, and so on.

For further information on the confirm routine, see Call Format for a Confirm Routine in the Description section.

**user-specified-argument**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

Value that LIB\$RENAME\_FILE passes to the success, error, and confirm routines each time they are called. Whatever mechanism is used to pass **user-specified-argument** to LIB\$RENAME\_FILE is also used to pass it to the user-supplied routines. This is an optional argument; if omitted, zero is passed by value.

**old-resultant-name**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String into which LIB\$RENAME\_FILE copies the old resultant file specification of the last file processed. This is an optional argument. If present, it is used to store the file specification passed to the user-supplied routines instead of a default class S, type T string. Any string class is supported.

If you are specifying one or more of the action routine arguments, be sure that the descriptor class used to pass **resultant-name** is the same as the descriptor class required by the action routine. For example, VAX Ada requires a class SB descriptor for string arguments to Ada routines, but will use a class A descriptor by default when calling external routines. Refer to your language manual to determine the proper descriptor class to use.

**new-resultant-name**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

String into which LIB\$RENAME\_FILE writes the new RMS resultant file specification of the last file processed. The **new-resultant-name** argument is the address of a descriptor pointing to the new name. This is an optional argument. If present, it is used to store the file specification passed to the user-supplied routines instead of a class S, type T string. Any string class is supported.

If you are specifying one or more of the action routine arguments, be sure that the descriptor class used to pass **resultant-name** is the same as the descriptor class required by the action routine. For example, VAX Ada requires a class SB descriptor for string arguments to Ada routines, but will use a class A descriptor by default when calling external routines. Refer to your language manual to determine the proper descriptor class to use.

## LIB\$ Routines

### LIB\$RENAME\_FILE

#### file-scan-context

OpenVMS usage: context  
type: longword (unsigned)  
access: modify  
mechanism: by reference

Context for renaming a list of file specifications. The **file-scan-context** is the address of a longword which contains this context. You must initialize this longword to zero before the first of a series of calls to LIB\$RENAME\_FILE. LIB\$RENAME\_FILE uses the file scan context to retain the file context for multiple input files.

LIB\$FILE\_SCAN uses this context to retain multiple input file related file context. This is an optional argument; it need only be specified if you are using multiple input files, as the DCL command RENAME does. You may deallocate the context allocated by LIB\$FILE\_SCAN while processing the LIB\$RENAME\_FILE requests by calling LIB\$FILE\_SCAN\_END after all calls to LIB\$RENAME\_FILE have been completed. See the description of LIB\$FILE\_SCAN for a more detailed description of this argument.

## Description

This description is divided into three parts.

- Call Format for a Success Routine
- Call Format for an Error Routine
- Call Format for a Confirm Routine

#### Call Format for a Success Routine

The success routine is optional; it is called only if the **user-success-procedure** argument is specified in the call to LIB\$RENAME\_FILE.

The calling format of a success routine is as follows:

```
user-success-procedure old-filespec ,new-filespec [,user-specified-argument]
```

#### old-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: descriptor

RMS resultant file specification of the file before it was renamed. If **old-resultant-name** was specified, it is used to pass the string to the success routine. Otherwise, a class S, type T string is passed. Any string class is supported.

#### new-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

RMS resultant file specification of the newly renamed file. If **new-resultant-name** was specified, it is used to pass the string to the success routine. Otherwise, a class S, type T string is passed. Any string class is supported.

**user-specified-argument**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: unspecified

Value of **user-specified-argument** passed by LIB\$RENAME\_FILE to the success routine using the same passing mechanism that was used to pass it to LIB\$RENAME\_FILE.

**Call Format for an Error Routine**

The error routine returns a success/fail value that LIB\$RENAME\_FILE uses to determine whether or not more files will be processed if an error is encountered. The error routine is called only if the **user-error-procedure** argument was specified in the call to LIB\$RENAME\_FILE. If the **user-error-procedure** argument was not specified, the default is to continue processing.

The calling format of the error routine is as follows:

**user-error-procedure** old-filespec ,new-filespec ,rms-sts ,rms-stv ,error-source ,user-specified-argument

**old-filespec**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

RMS resultant file specification of the file being renamed when the error occurred. If **old-resultant-name** was specified, it is used to pass the string to the error routine. Otherwise, a class S, type T string is passed. Any string class is supported.

**new-filespec**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

RMS resultant file specification of the new file name being used when the error occurred. If **new-resultant-name** was specified, it is used to pass the string to the error routine. Otherwise, a class S, type T string is passed. Any string class is supported.

**rms-sts**

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Primary condition code (FAB\$L\_STS) which describes the error that occurred. The **rms-sts** argument is the address of an unsigned longword that contains this primary condition code.

**rms-stv**

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by reference

## LIB\$ Routines

### LIB\$RENAME\_FILE

Secondary condition code (FAB\$L\_STV) which describes the error that occurred. The **rms-stv** argument is the address of an unsigned longword that contains this secondary condition code.

#### **error-source**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Integer code indicating where the error was found. The **error-source** argument is the address of a longword containing the error source.

The values of **error-source** and their meanings are as follows:

- 0 Error searching for **old-filespec**
- 1 Error parsing **new-filespec**
- 2 Error renaming file

#### **user-specified-argument**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: unspecified

Value of **user-specified-argument** that LIB\$RENAME\_FILE passes to the error routine using the same passing mechanism that was used to pass it to LIB\$RENAME\_FILE.

If the error routine returns a success status (bit 0 set), then LIB\$RENAME\_FILE will continue processing files. If the error routine returns a failure status (bit 0 clear), processing ceases immediately and LIB\$RENAME\_FILE returns with an error status.

If the **user-error-procedure** argument is not specified, LIB\$RENAME\_FILE will return to its caller the most severe error status encountered while renaming the files. If the error routine is called for an error, the success status LIB\$ERRROUCAL is returned.

The error routine is not called for errors related to string copying.

#### **Call Format for a Confirm Routine**

The calling format of a confirm routine is as follows:

```
user-confirm-procedure old-filespec ,new-filespec ,old-fab [,user-specified-argument]
```

#### **old-filespec**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

RMS resultant file specification of the file about to be renamed. If **old-resultant-name** was specified, it is used to pass the string to the confirm routine. Otherwise, a class S, type T string is passed. Any string class is supported.

**new-filespec**

OpenVMS usage: char\_string  
 type: character string  
 access: read only  
 mechanism: by descriptor

RMS resultant file specification which the file will be given. If **new-resultant-name** was specified, it is used to pass the string to the confirm routine. Otherwise, a class S, type T string is passed. Any string class is supported.

**old-fab**

OpenVMS usage: fab  
 type: unspecified  
 access: read only  
 mechanism: by reference

Address of the RMS FAB that describes the file being renamed. Your program may perform an RMS \$OPEN on the FAB to obtain file attributes it needs to determine whether the file should be renamed, but must close the file with \$CLOSE before returning to LIB\$RENAME\_FILE.

**user-specified-argument**

OpenVMS usage: user\_arg  
 type: longword (unsigned)  
 access: read only  
 mechanism: unspecified

Value of **user-specified-argument** passed by LIB\$RENAME\_FILE to the confirm routine using the same passing mechanism that was used to pass it to LIB\$RENAME\_FILE. This is an optional argument.

If the confirm routine returns a success value (bit 0 set), the file is renamed; otherwise, the file is not renamed.

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_ERRROUCAL | Success—error routine called. A file error was encountered but the error routine was called to handle the condition.                  |
| LIB\$_INVARG    | Invalid argument. The <b>flags</b> argument has one or more undefined bits set.   |
| LIB\$_INVFILSPE | Invalid file specification. <b>Old-filespec</b> , <b>new-filespec</b> , or <b>default-filespec</b> contains more than 255 characters. |
| LIB\$_INVSTRDES | Invalid string descriptor. One of the string argument descriptors was not a valid string descriptor.                                  |
| LIB\$_WRONUMARG | Wrong number of arguments. An incorrect number of arguments was passed to LIB\$RENAME_FILE.   |

Any condition value returned by LIB\$SCOPY\_xxx; truncation errors are ignored.

**LIB\$ Routines**  
**LIB\$RENAME\_FILE**

Any condition value returned by RMS. If the **user-error-procedure** argument was not specified, this is the most severe of the RMS errors which occurred while renaming the files.

---

## LIB\$RESERVE\_EF Reserve Event Flag

The Reserve Event Flag routine allocates a local event flag number specified by **event-flag-number**.

### Format

LIB\$RESERVE\_EF event-flag-number

### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

### argument

**event-flag-number**  
 OpenVMS usage: ef\_number  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Event flag number to be allocated by LIB\$RESERVE\_EF. The **event-flag-number** argument contains the address of a signed longword integer that is this event flag number.

### Description

LIB\$RESERVE\_EF allocates a particular local event flag number. It differs from LIB\$GET\_EF, which allocates an arbitrary event flag.

Use LIB\$FREE\_EF to deallocate an event flag reserved with LIB\$RESERVE\_EF.

Event flags 1 through 23 are initially reserved. Use LIB\$FREE\_EF to deallocate an event flag in this range before reserving it.

See the LIB\$GET\_EF routine for more information about handling local event flags.

### Condition Values Returned

|                |  |
|----------------|--|
| SS\$NORMAL     | Routine successfully completed.  |
| LIB\$EF_ALRRES | Event flag already reserved.   |
| LIB\$EF_RESSYS | Event flag reserved to system. This occurs if the event flag number is outside the ranges of 1 through 23 and 32 through 63. |

## LIB\$ Routines LIB\$RESERVE\_EF

### Example

```
PROGRAM RESERVE_EF(INPUT, OUTPUT);  
  
routine LIB$RESERVE_EF(%REF EVENT_FLAG_NUM : INTEGER); EXTERN;  
routine LIB$FREE_EF(%REF EVENT_FLAG_NUM : INTEGER); EXTERN;  
  
VAR  
    FLAG_NUM : INTEGER;  
  
BEGIN  
    FLAG_NUM := 37;  
    LIB$RESERVE_EF(FLAG_NUM);  
    WRITELN(FLAG_NUM);  
    LIB$FREE_EF(FLAG_NUM);  
END.
```

The output generated by this Pascal example program is as follows:

37

---

## LIB\$RESET\_VM\_ZONE

### Reset Virtual Memory Zone

The Reset Virtual Memory Zone routine frees all blocks of memory that were previously allocated from a zone in the 32-bit virtual address space.†

#### Format

LIB\$RESET\_VM\_ZONE zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**zone-id**  
OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier. The **zone-id** is the address of a longword that contains the identifier of a zone created by a previous call to LIB\$CREATE\_VM\_ZONE or LIB\$CREATE\_USER\_VM\_ZONE.

#### Description

LIB\$RESET\_VM\_ZONE frees all the blocks of memory that were previously allocated from the zone. The memory becomes available to satisfy further allocation requests for the zone; the memory is not returned to the processwide 32-bit page pool managed by LIB\$GET\_VM\_PAGE. Your program can continue to use the zone after you call LIB\$RESET\_VM\_ZONE.

Resetting a zone is a much more efficient way to reuse storage than individually freeing each allocated object in the zone.

It is the caller's responsibility to ensure that he or she has "exclusive" access to the zone while the reset operation is being performed. Results are unpredictable if another thread of control attempts to perform any operation on the zone while LIB\$RESET\_VM\_ZONE is in progress.

If you specified deallocation filling when you created the zone, LIB\$RESET\_VM\_ZONE will fill all of the allocated blocks that are freed.

If the zone you are resetting was created using the LIB\$CREATE\_USER\_VM\_ZONE routine, then you must have an appropriate action routine for the reset operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE, you must have specified a **user-reset-procedure**.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

**LIB\$ Routines**  
**LIB\$RESET\_VM\_ZONE**

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_BADBLOADR

An invalid **zone-id** argument.

---

## LIB\$RESET\_VM\_ZONE\_64 (Alpha Only)

### Reset Virtual Memory Zone

The Reset Virtual Memory Zone routine frees all blocks of memory that were previously allocated from a zone in the 64-bit virtual address space.

#### Format

LIB\$RESET\_VM\_ZONE\_64 zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**zone-id**  
OpenVMS usage: identifier  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier. The **zone-id** is the address of a quadword that contains the identifier of a zone created by a previous call to LIB\$CREATE\_VM\_ZONE\_64 or LIB\$CREATE\_USER\_VM\_ZONE\_64.

#### Description

LIB\$RESET\_VM\_ZONE\_64 frees all the blocks of memory that were previously allocated from the zone. The memory becomes available to satisfy further allocation requests for the zone; the memory is not returned to the processwide 64-bit page pool managed by LIB\$GET\_VM\_PAGE\_64. Your program can continue to use the zone after you call LIB\$RESET\_VM\_ZONE\_64.

Resetting a zone is a much more efficient way to reuse storage than individually freeing each allocated object in the zone.

It is the caller's responsibility to ensure that he or she has "exclusive" access to the zone while the reset operation is being performed. Results are unpredictable if another thread of control attempts to perform any operation on the zone while LIB\$RESET\_VM\_ZONE\_64 is in progress.

If you specified deallocation filling when you created the zone, LIB\$RESET\_VM\_ZONE\_64 will fill all of the allocated blocks that are freed.

If the zone you are resetting was created using the LIB\$CREATE\_USER\_VM\_ZONE\_64 routine, then you must have an appropriate action routine for the reset operation. That is, in your call to LIB\$CREATE\_USER\_VM\_ZONE\_64, you must have specified a **user-reset-procedure**.

**LIB\$ Routines**  
**LIB\$RESET\_VM\_ZONE\_64 (Alpha Only)**

**Condition Values Returned**

|                  |                                     |
|------------------|-------------------------------------|
| SS\$ _NORMAL     | Routine successfully completed.     |
| LIB\$ _BADBLOADR | An invalid <b>zone-id</b> argument. |

---

## LIB\$REVERT

### Revert to the Handler of the Routine Activator

The Revert to the Handler of the Routine Activator routine deletes the condition handler established by LIB\$ESTABLISH by clearing the address pointing to the condition handler from the activated routine's stack frame.†

**Alpha**

This routine is not available to native OpenVMS Alpha programs but is recognized and handled appropriately by most Digital high-level language compilers. ♦

#### Format

LIB\$REVERT

#### Returns

OpenVMS usage: address  
type: address  
access: write only  
mechanism: by value

Previous contents of SF\$A\_HANDLER (longword 0) of the caller's stack frame. This is the address of the condition handler previously in effect. If no condition handler was in effect, zero is returned.

#### Arguments

None.

#### Description

LIB\$REVERT returns the address that it clears from the calling routine's stack frame. LIB\$REVERT is used only if your routine is to establish and then cancel a condition handler for a portion of its execution.

LIB\$REVERT is provided primarily for use with languages without built-in error-handling facilities, such as Fortran. Do not use LIB\$REVERT from BASIC, COBOL, Pascal, or PL/I. See the documentation for the language you are using for information about how that language handles errors.

In VAX MACRO, you merely use the following instruction rather than calling LIB\$REVERT:

```
CLRL      (FP)      ; set handler address to 0  
                        ; in current stack frame
```

#### Condition Values Returned

None.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$RUN\_PROGRAM

### Run New Program

The Run New Program routine causes the current program to stop running and begins execution of another program.

#### Format

LIB\$RUN\_PROGRAM program-name

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**program-name**  
OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File name of the program to be run in place of the current program. The **program-name** argument contains the address of a descriptor pointing to this file name string.

The maximum length of the file name is 255 characters. The default file type is .EXE.

#### Description

LIB\$RUN\_PROGRAM stops execution of the current program and begins execution of another program.

- If successful, control does not return to the calling program. Instead, the \$EXIT system service is called, the new program image replaces the old image in the user process, and the command interpreter gives control to the new image.
- If unsuccessful, control returns to the command interpreter.

This routine is supported for use with the DCL and MCR CLIs. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In those cases, the error status LIB\$\_NOCLI is returned.

LIB\$RUN\_PROGRAM causes the current image to exit at the point of the call and directs the command language interpreter (CLI), if one is present, to start running another program. If LIB\$RUN\_PROGRAM executes successfully, control passes to the second program; if not, control passes to the command language interpreter. The calling program cannot regain control. This technique is called chaining.

This routine is provided primarily for compatibility with PDP-11 systems, where chaining is used to extend the address space of a system.

This routine may also be useful in an OpenVMS environment where address space is severely limited and large images are not possible. For example, you might use chaining to perform system generation on a small virtual address space, for a large page file.

With LIB\$RUN\_PROGRAM, the calling program can pass arguments to the next program in the chain only by using the common storage area. One way to do this is for the calling program to call LIB\$PUT\_COMMON to pass the information into the common storage area. Then the called program calls LIB\$GET\_COMMON to retrieve the data.

In general, this practice is not recommended. There is no convenient way to specify the order and type of arguments passed into the common storage area; so programs that pass arguments in this way must know about the format of the data before it is passed. When you use common storage, it is very difficult to keep your program modular and AST-reentrant; a method of arbitration must be designated to define which program can modify common storage and when.

Further, LIB\$RUN\_PROGRAM cannot be used if no command language interpreter is present, as in the case of image subprocesses and detached subprocesses.

If you want control to return to the caller, use LIB\$SPAWN instead.

### **Condition Values Returned**

|                 |   |
|-----------------|---|
| LIB\$_INVARG    | Invalid argument.   |
| LIB\$_NOCLI     | No CLI present to perform function. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.   |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL or MCR CLIs, please report the problem to Digital in a Software Performance Report (SPR). |

---

## LIB\$SCANC

### Scan for Characters and Return Relative Position

The Scan for Characters and Return Relative Position routine is used to find a specified set of characters in the source string. LIB\$SCANC makes the VAX SCANC instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$SCANC source-string ,table-array ,byte-integer-mask

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

Relative position in the source string of the character that terminated the operation, or zero if the terminator character is not found. If the source string has a zero length, then a zero is returned.

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string used by LIB\$SCANC to index into a table. The **source-string** argument contains the address of a descriptor pointing to this source string.

##### table-array

OpenVMS usage: vector\_mask\_byte  
type: byte (unsigned)  
access: read only  
mechanism: by reference, array reference

Table that LIB\$SCANC indexes into and performs a logical AND operation with the **byte-integer-mask** byte. The **table-array** argument contains the address of an unsigned byte array that is this table.

##### byte-integer-mask

OpenVMS usage: mask\_byte  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Mask on which a logical AND operation is performed with bytes in **table-array**. The **byte-integer-mask** argument contains the address of an unsigned byte that is this mask.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

### Description

LIB\$SCANC uses successive bytes of the string specified by **source-string** to index into a table. The byte selected from the table is the byte on which a logical AND operation is performed with the mask byte. The operation is terminated when the result of the AND operation is equal to 1.

### Condition Values Returned

None.

---

## LIB\$COPY\_DXDX

### Copy Source String Passed by Descriptor to Destination

The Copy Source String Passed by Descriptor to Destination routine copies a source string passed by descriptor to a destination string.

#### Format

LIB\$COPY\_DXDX source-string ,destination-string

#### Corresponding JSB Entry Point

LIB\$COPY\_DXDX6

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string to be copied to the destination string by LIB\$COPY\_DXDX. The **source-string** argument contains the address of a descriptor pointing to this source string. The descriptor class can be unspecified, fixed-length, decimal string, array, noncontiguous array, varying, or dynamic.

##### destination-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string to which the source string is copied. The **destination-string** argument contains the address of a descriptor pointing to this destination string.

The following actions occur depending on the class of the destination string's descriptor:

| Descriptor Class | Action   |
|------------------|--|
| S, Z, SD, A, NCA | Copy the source string. If needed, space-fill or truncate on the right.  |
| D                | If the area specified by the destination descriptor is large enough to contain the source string, copy the source string and set the new length in the destination descriptor. If the area specified is not large enough, return the previous space allocation (if any) and then dynamically allocate the amount of space needed. Copy the source string and set the new length and address in the destination descriptor. |
| VS               | Copy source string to destination string up to the limit of the descriptor MAXSTRLEN field with no padding. Readjust the current length (CURLen) field to the actual number of bytes copied.   |

### Description

LIB\$COPY\_DXDX returns all condition values as a status; truncation is a qualified success condition value (bit 0 set to 1).

In addition, an equivalent JSB entry point is available, with R0 containing the first argument and R1 containing the second.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed. All characters in the input string were copied to the destination string.  |
| LIB\$_STRTRU    | Routine successfully completed. String truncated. The destination string could not contain all of the characters copied from the source string.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |

## LIB\$COPY\_R\_DX

### Copy Source String Passed by Reference to Destination String

The Copy Source String Passed by Reference to Destination String routine copies a source string passed by reference to a destination string, passed by descriptor.

#### Format

LIB\$COPY\_R\_DX word-integer-source-length ,source-string ,destination-string

#### Corresponding JSB Entry Point

LIB\$COPY\_R\_DX6

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### **word-integer-source-length**

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Length of the source string in bytes. The **word-integer-source-length** argument is the address of an unsigned word that contains the length of the source string.

##### **source-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by reference

Source string to be copied to the destination string by LIB\$COPY\_R\_DX. The **source-string** argument is the address of this source string.

##### **destination-string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string to which the source string is copied. The **destination-string** argument contains the address of a descriptor pointing to this destination string.

## Description

LIB\$SCOPY\_R\_DX copies a source string, passed by reference, to a destination string, passed by descriptor. It returns the status as a condition value. Truncation is a qualified success; LIB\$SCOPY\_R\_DX sets bit 0 of the condition value to 1.

The actions taken by LIB\$SCOPY\_R\_DX depend on the descriptor class of the destination string. The following table describes these actions for each descriptor class.

| Descriptor Class | Action  |
|------------------|---|
| S, Z, SD, A, NCA | Copy the source string. If needed, space fill or truncate on the right.   |
| D                | If the area specified by the destination descriptor is large enough to contain the source string, copy the source string and set the new length in the destination descriptor.<br>If the area specified is not large enough, return the previous space allocation, if any, and then dynamically allocate the amount of space needed. Copy the source string and set the new length and address in the destination descriptor. |
| VS               | Copy source string to destination string up to the limit of the descriptor's MAXSTRLEN field with no padding. Readjust the string's current length (CURLen) field to the actual number of bytes copied.   |

An equivalent JSB entry is available, with R0 being the first argument, R1 the second, and R2 the third. The length argument is passed in bits 15:0 of R0.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed. All characters in the input string were copied to the destination string.  |
| LIB\$_STRTRU    | Routine successfully completed. String truncated. The destination string could not contain all of the characters copied from the source string.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |

## LIB\$COPY\_R\_DX\_64 (Alpha Only)

### Copy Source String Passed by Reference to Destination String

The Copy Source String Passed by Reference to Destination String routine copies a source string passed by reference to a destination string, passed by descriptor.

#### Format

LIB\$COPY\_R\_DX\_64 quad-integer-source-length ,source-string ,destination-string

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### quad-integer-source-length

OpenVMS usage: quadword\_unsigned  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Length of the source string in bytes. The **quad-integer-source-length** argument is the address of an unsigned quadword that contains the length of the source string.

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by reference

Source string to be copied to the destination string by LIB\$COPY\_R\_DX\_64. The **source-string** argument is the address of this source string.

##### destination-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string to which the source string is copied. The **destination-string** argument contains the address of a descriptor pointing to this destination string.

#### Description

LIB\$COPY\_R\_DX\_64 copies a source string, passed by reference, to a destination string, passed by descriptor. It returns the status as a condition value. Truncation is a qualified success; LIB\$COPY\_R\_DX\_64 sets bit 0 of the condition value to 1.

## LIB\$ Routines LIB\$COPY\_R\_DX\_64 (Alpha Only)

The actions taken by LIB\$COPY\_R\_DX\_64 depend on the descriptor class of the destination string. The following table describes these actions for each descriptor class.

| Descriptor Class | Action  |
|------------------|---|
| S, Z, SD, A, NCA | Copy the source string. If needed, space fill or truncate on the right.   |
| D                | If the area specified by the destination descriptor is large enough to contain the source string, copy the source string and set the new length in the destination descriptor.<br>If the area specified is not large enough, return the previous space allocation, if any, and then dynamically allocate the amount of space needed. Copy the source string and set the new length and address in the destination descriptor. |
| VS               | Copy source string to destination string up to the limit of the descriptor's MAXSTRLEN field with no padding. Readjust the string's current length (CURLLEN) field to the actual number of bytes copied.  |

### Condition Values Returned

|                |  |
|----------------|--|
| SS\$NORMAL     | Routine successfully completed. All characters in the input string were copied to the destination string.  |
| LIB\$STRTRU    | Routine successfully completed. String truncated. The destination string could not contain all of the characters copied from the source string.  |
| LIB\$FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |

---

## LIB\$SET\_LOGICAL

### Set Logical Name

The Set Logical Name routine requests the calling process's command language interpreter (CLI) to define or redefine a supervisor-mode process logical name. It provides the same function as the DCL command DEFINE.

#### Format

LIB\$SET\_LOGICAL logical-name [,value-string] [,table] [,attributes] [,item-list]

Either the **item-list** or **value-string** argument must be specified. If both **item-list** and **value-string** are specified, the **value-string** argument is ignored.

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### logical-name

OpenVMS usage: logical\_name  
type: character string  
access: read only  
mechanism: by descriptor

Logical name to be defined or redefined. The **logical-name** argument contains the address of a descriptor pointing to this logical name string. The maximum length of a logical name is 255 characters. Note that logical names are case sensitive.

##### value-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Value to be given to the logical name. The **value-string** argument contains the address of a descriptor pointing to this value string. The maximum length of a logical name value is 255 characters.

If omitted, an item list must be present to specify the values of the logical name.

##### table

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name of the table in which to create the logical name. The **table** argument contains the address of a descriptor pointing to the logical name table. If no table is specified, LNM\$PROCESS is used as the default.

### attributes

OpenVMS usage: mask\_longword  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Logical name or translation attributes. The **attributes** argument is the address of a longword bit mask that contains the logical name or translation attributes.

LNМ\$M\_CONFINE and LNМ\$M\_NO\_ALIAS are currently available logical name attributes. See the description of the \$CRELNМ system service in the *OpenVMS System Services Reference Manual* for definitions of LNМ\$M\_CONFINE and LNМ\$M\_NO\_ALIAS. If omitted, no special logical name attribute is established.

If no **item-list** is specified, the translation attributes LNМ\$M\_CONCEALED and LNМ\$M\_TERMINAL may be specified. See the description of the ASSIGN command in the *OpenVMS DCL Dictionary* for definitions of these attributes. If an **item-list** is specified, it will contain the translation attributes for each equivalence string in the attribute.

### item-list

OpenVMS usage: item\_list\_3  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Item list describing the equivalence names for this logical name. The **item-list** argument contains the address of an array that contains this item list. If **item-list** is not specified, the logical name will have only one value, as specified in the **value-string** argument. Item codes for use with this item list are included in Digital-supplied libraries in module \$LNМDEF.

Either **value-string** or **item-list** must be specified. If neither is specified, the LIB\$\_INVARG error is produced. If both **value-string** and **item-list** are specified, the **value-string** argument is ignored.

If **item-list** is specified, only logical name attributes are permitted. Translation attributes appear in the item list.

The **item-list** argument is needed only when you want to create multiple equivalence strings for a single logical name.

## Description

If the optional **table** argument is defined, the logical name will be placed in the table specified by the **table** argument; otherwise, the logical name is placed in the LNМ\$PROCESS table.

Unlike the system services \$CRELOG and \$CRELNМ, LIB\$SET\_LOGICAL does not require the caller to be executing in supervisor mode to define a supervisor-mode logical name. Supervisor-mode logical names are not deleted when an image exits. A program can obtain the current value of any logical name by calling the system service \$TRNLNМ. For more information on logical names, see the *OpenVMS System Services Reference Manual*.

## LIB\$ Routines

### LIB\$SET\_LOGICAL

This routine is supported for use with the DCL and MCR command language interpreters. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In that case, the error status LIB\$\_NOCLI is returned.

This routine does not support the DCL DEFINE and DEASSIGN commands' special side-effect of opening and closing a process-permanent file if the logical name "SYS\$OUTPUT" is specified.

See the *OpenVMS DCL Dictionary* for a description of the DCL DEFINE command.

### Condition Values Returned

|                  |  |
|------------------|--|
| SS\$_NORMAL      | Routine successfully completed.  |
| SS\$_SUPERSEDE   | Routine successfully completed; the previous definition of the logical name was replaced.  |
| SS\$_BUFFEROVF   | Routine successfully completed; however, a buffer overflow occurred.   |
| SS\$_ACCVIO      | Access violation. The logical name or its value could not be read.   |
| SS\$_BADPARAM    | Bad argument.  |
| SS\$_INSFMEM     | Insufficient dynamic memory.   |
| SS\$_IVLOGNAM    | Invalid logical name. The logical name or its value contained more than 255 characters.  |
| SS\$_IVLOGTAB    | Invalid logical name table.  |
| SS\$_NOPRIV      | No privileges for attempted operation.   |
| SS\$_TOOMANYLNAM | Logical name translation exceeded allowed depth.   |
| LIB\$_INVARG     | Neither the <b>value-string</b> nor the <b>item-list</b> argument was specified.   |
| LIB\$_INVSTRDES  | Invalid string descriptor.   |
| LIB\$_NOCLI      | No CLI present to perform function. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.  |
| LIB\$_UNECLIERR  | Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to Digital in a Software Performance Report (SPR). |

## Example

```
!+  
! Initialize value for logical name MY_LOG  
!-  
SYMBOL$ = 'MY_LOG'  
SETVAL$ = 'OFF'  
CALL LIB$SET_LOGICAL (SYMBOL$, SETVAL$)  
END
```

The BASIC program above sets the logical MY\_LOG to OFF. This value can be displayed after the program is run with SHOW LOGICAL as follows:

```
$ SHOW LOGICAL MY_LOG  
"MY_LOG" = "OFF" (LNM$PROCESS_TABLE)
```

## LIB\$SET\_SYMBOL

### Set Value of CLI Symbol

The Set Value of CLI Symbol routine requests the calling process's command language interpreter (CLI) to define or redefine a CLI symbol.

#### Format

LIB\$SET\_SYMBOL symbol ,value-string [,table-type-indicator]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### symbol

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Name of the symbol to be defined or modified by LIB\$SET\_SYMBOL. The **symbol** argument is the address of a descriptor pointing to this symbol string. If you redefine a previously defined CLI symbol, the symbol value is modified to the new value that you provide.

The symbol name is converted to uppercase and trailing blanks are removed before use. The **symbol** argument must begin with a letter, a digit, a dollar sign (\$), a hyphen (-), or an underscore (\_). The maximum length of **symbol** is 255 characters.

##### value-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Value to be given to the symbol. The **value-string** argument is the address of a descriptor pointing to this value string.

Trailing blanks are not removed from the value string before use. The maximum length of **value-string** is 255 characters. Integer values are not allowed; LIB\$SET\_SYMBOL is intended to set string CLI symbols, not integer CLI symbols.

**table-type-indicator**

OpenVMS usage: longword\_signed  
 type: longword integer (signed)  
 access: read only  
 mechanism: by reference

Indicator of the table which will contain the defined symbol. The **table-type-indicator** argument is the address of a signed longword integer that is this table indicator.

If omitted, the local symbol table is used. The following are possible values for **table-type-indicator**:

| Symbolic Name         | Value | Table Used          |
|-----------------------|-------|---------------------|
| LIB\$K_CLI_LOCAL_SYM  | 1     | Local symbol table  |
| LIB\$K_CLI_GLOBAL_SYM | 2     | Global symbol table |

**Description**

LIB\$SET\_SYMBOL requests the calling process's command language interpreter (CLI) to define or redefine a CLI symbol.

CLI symbols created using LIB\$SET\_SYMBOL may be inaccessible by other CLI commands. To avoid this situation, make sure that your symbol names are alphanumeric and that the first character is alphabetic. LIB\$SET\_SYMBOL is intended to set string CLI symbols, not integer CLI symbols.

LIB\$K\_CLI\_LOCAL\_SYM and LIB\$K\_CLI\_GLOBAL\_SYM are defined as global symbols and in Digital-supplied symbol libraries (macro or module name \$LIBCLIDEF).

This routine is supported for use with the DCL command language interpreter. If used with the MCR CLI, the error status LIB\$\_NOCLI will be returned. If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In this case, the error status LIB\$\_NOCLI is returned.

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_AMBSYMDEF | Ambiguous symbol definition. The symbol name you want to define is ambiguous when compared with existing symbol names. This condition might arise if abbreviated symbols have been defined previously. See the <i>OpenVMS DCL Dictionary</i> for more information on abbreviated symbols. |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR).  |

## LIB\$ Routines

### LIB\$SET\_SYMBOL

|                 |  |
|-----------------|--|
| LIB\$_INSCLIMEM | Insufficient CLI memory. The CLI could not get enough virtual memory to assign another symbol. This condition may be caused by having too many symbols defined; deleting some symbol definitions may make enough room for the new symbol.  |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVARG    | Invalid argument. The value of <b>table-type-indicator</b> was invalid or the length of <b>value-string</b> was greater than 255 characters.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |
| LIB\$_INVSYMNAM | Invalid symbol name. The length of <b>symbol</b> was greater than 255 characters or <b>symbol</b> did not begin with a letter.   |
| LIB\$_NOCLI     | No CLI present to perform function. The calling process did not have a CLI to perform the function or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI.  |
| LIB\$_UNECLIERR | Unexpected CLI error. The CLI returned an error status which was not recognized. This error may be caused by use of a nonstandard CLI. If this error occurs while using the DCL command language interpreter, please report the problem to Digital in a Software Performance Report (SPR). |

### Example

```
!+
! Initialize value and symbol name
!-
SYMBOL$ = 'MY_SYM'
SETVAL$ = 'ON'
CALL LIB$SET_SYMBOL (SYMBOL$, SETVAL$)
END
```

The BASIC program above sets the symbol MY\_SYM to ON. This value can be displayed after the program is run with SHOW SYMBOL as follows:

```
$ SHOW SYMBOL MY_SYM
"MY_SYM" = "ON" (LNM$PROCESS_TABLE)
```

---

## LIB\$SFREE1\_DD

### Free One Dynamic String

The Free One Dynamic String routine returns the dynamically allocated storage for a dynamic string.

#### Format

LIB\$SFREE1\_DD descriptor-address

#### Corresponding JSB entry point

LIB\$SFREE1\_DD6

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

##### descriptor-address

OpenVMS usage: descriptor  
type: quadword (unsigned)  
access: modify  
mechanism: by reference

Dynamic descriptor specifying the area to be deallocated. The **descriptor-address** argument is the address of an unsigned quadword that is this descriptor. The descriptor is assumed to be dynamic and its class field is not checked.

#### Description

Before a routine deallocates a dynamic descriptor, it must use LIB\$SFREE1\_DD or LIB\$SFREEN\_DD to deallocate the string storage space specified by the dynamic descriptor. Otherwise, string storage is not deallocated and your program can run out of memory.

This routine deallocates the described string space and flags the descriptor as describing no string at all. The descriptor's POINTER and LENGTH fields contain zero (0).

#### Condition Values Returned

|                 |                                 |
|-----------------|---------------------------------|
| SS\$_NORMAL     | Routine successfully completed. |
| LIB\$_FATERRLIB | Fatal internal error.           |

---

## LIB\$SFREEN\_DD

### Free One or More Dynamic Strings

The Free One or More Dynamic Strings routine returns one or more dynamic strings to free storage.

#### Format

LIB\$SFREEN\_DD number-of-descriptors ,first-descriptor-array

#### Corresponding JSB Entry Point

LIB\$SFREEN\_DD6

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### number-of-descriptors

OpenVMS usage: longword\_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Number of adjacent descriptors freed by LIB\$SFREEN\_DD. The **number-of-descriptors** argument contains the address of an unsigned longword that is this number. The deallocated area is returned to free storage.

##### first-descriptor-array

OpenVMS usage: descriptor\_array  
type: quadword (unsigned)  
access: modify  
mechanism: by reference, array reference

First descriptor of an array of descriptors. The **first-descriptor-array** argument contains the address of this first descriptor. The descriptors are assumed to be dynamic, and their class fields are not checked.

The descriptor array must contain all 32-bit descriptors or all 64-bit descriptors. They cannot be mixed.

#### Description

Before a routine that allocates space returns to its caller, it must use LIB\$SFREE1\_DD or LIB\$SFREEN\_DD to deallocate the string storage space specified by any descriptors located in the stack. Otherwise, space is not deallocated and your program could run out of virtual memory.

LIB\$SFREEN\_DD deallocates the described string space and flags each descriptor as describing no string at all by setting the descriptor's POINTER and LENGTH fields to 0 (zero).

**Condition Values Returned**

SS\$\_NORMAL  
LIB\$\_FATERRLIB

Routine successfully completed.  
Fatal internal error.

---

## LIB\$SGET1\_DD

### Get One Dynamic String

The Get One Dynamic String routine allocates dynamic virtual memory to the string descriptor you specify.

#### Format

LIB\$SGET1\_DD word-integer-length ,descriptor-part

#### Corresponding JSB entry point

LIB\$SGET1\_DD\_R6

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### word-integer-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Number of bytes of dynamic virtual memory to be allocated by LIB\$SGET1\_DD. The **word-integer-length** argument is the address of an unsigned word that contains this number. The amount of storage allocated may be rounded up automatically.

##### descriptor-part

OpenVMS usage: quadword\_unsigned  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Descriptor of the dynamic string to which LIB\$SGET1\_DD allocates the dynamic virtual memory. The **descriptor-part** argument contains the address of this descriptor.

The **descriptor-part** argument must contain the address of a dynamic string descriptor; LIB\$SGET1\_DD returns an unpredictable result if any other type of descriptor is specified by this argument.

The descriptor CLASS field is not checked but is set to dynamic (2). The LENGTH field is set to **word-integer-length**, and the POINTER field points to the string area allocated.

## Description

LIB\$SGET1\_DD is similar to LIB\$SCOPY\_DXDX except that no source string is copied. You can write anything you want in the allocated area.

If **descriptor-part** already has dynamic memory allocated to it, but the amount allocated is less than **word-integer-length**, that space is deallocated before LIB\$SGET1\_DD allocates new space.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |

## LIB\$SGET1\_DD\_64 (Alpha Only) Get One Dynamic String

The Get One Dynamic String routine allocates dynamic virtual memory to the string descriptor you specify.

### Format

LIB\$SGET1\_DD\_64 quad-integer-length ,descriptor-part

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### quad-integer-length

OpenVMS usage: quadword\_unsigned  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Number of bytes of dynamic virtual memory to be allocated by LIB\$SGET1\_DD\_64. The **quad-integer-length** argument is the address of an unsigned quadword that contains this number. The amount of storage allocated can be rounded up automatically.

#### descriptor-part

OpenVMS usage: quadword\_unsigned  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Descriptor of the dynamic string to which LIB\$SGET1\_DD\_64 allocates the dynamic virtual memory. The **descriptor-part** argument contains the address of this descriptor.

The **descriptor-part** argument must contain the address of a dynamic string descriptor; LIB\$SGET1\_DD\_64 returns an unpredictable result if any other type of descriptor is specified by this argument.

The descriptor CLASS field is not checked but is set to dynamic (2). The LENGTH field is set to **quad-integer-length**, and the POINTER field points to the string area allocated.

### Description

LIB\$SGET1\_DD\_64 is similar to LIB\$SCOPY\_DXDX except that no source string is copied. You can write anything you want in the allocated area.

If **descriptor-part** already has dynamic memory allocated to it, but the amount allocated is less than **quad-integer-length**, that space is deallocated before LIB\$SGET1\_DD\_64 allocates new space.

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_FATERRLIB

Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR).

LIB\$\_INSVIRMEM

Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.

## LIB\$SHOW\_TIMER

### Show Accumulated Times and Counts

The Show Accumulated Times and Counts routine returns times and counts accumulated since the last call to LIB\$INIT\_TIMER and displays them on SYS\$OUTPUT. (LIB\$INIT\_TIMER must be called prior to invoking this routine.) A user-supplied action routine may change this default behavior.

#### Format

LIB\$SHOW\_TIMER [handle-address] [,code] [,user-action-procedure] [,user-argument-value]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### handle-address

OpenVMS usage: address  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Block of storage containing the value returned by a previous call to LIB\$INIT\_TIMER. The **handle-address** argument is the address of an unsigned longword integer containing that value.

- If specified, the pointer must be the same value returned by a previous call to LIB\$INIT\_TIMER.
- If omitted, LIB\$SHOW\_TIMER will use a block of memory allocated by LIB\$INIT\_TIMER.
- If **handle-address** is omitted and LIB\$INIT\_TIMER has not been called previously, the error LIB\$\_INVARG is returned. LIB\$INIT\_TIMER must be called prior to a call to LIB\$SHOW\_TIMER.

LIB\$SHOW\_TIMER assumes that LIB\$INIT\_TIMER has been previously called, and that the results of that call are stored either in a block pointed to by **handle-address**, or in the memory allocated by LIB\$INIT\_TIMER.

##### code

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

Integer specifying the statistic you want; if it is omitted or zero, all five statistics are returned on one line. The **code** argument is the address of a signed longword integer containing the statistic code.

The following values are allowed for the **code** argument:

| Value | Description  |
|-------|--------------|
| 1     | Elapsed time |
| 2     | CPU time     |
| 3     | Buffered I/O |
| 4     | Direct I/O   |
| 5     | Page faults  |

#### user-action-procedure

OpenVMS usage: procedure  
 type: procedure value  
 access: function call (before return)  
 mechanism: by value

User-supplied action routine called by LIB\$SHOW\_TIMER. The default action of LIB\$SHOW\_TIMER is to write the results to SYS\$OUTPUT. An action routine is useful if you want to write the results to a file or, in general, anywhere other than SYS\$OUTPUT.

The action routine returns either a success or failure condition value; this status is returned to the calling program as the value of LIB\$SHOW\_TIMER.

#### user-argument-value

OpenVMS usage: user\_arg  
 type: longword (unsigned) (on VAX and Alpha systems)  
 quadword (unsigned) (on Alpha systems)  
 access: read only  
 mechanism: by reference

A value to be passed to the action routine without interpretation. If omitted, LIB\$SHOW\_TIMER passes a zero by value to the user routine.

## Description

LIB\$SHOW\_TIMER returns the times and counts accumulated since the last call to LIB\$INIT\_TIMER. By default, when neither **code** nor **user-action-procedure** is specified in the call, LIB\$SHOW\_TIMER writes to SYS\$OUTPUT a line giving the following information:

| Shown on Line              | Description                      |
|----------------------------|----------------------------------|
| ELAPSED = dddd hh:mm:ss.cc | Elapsed real time                |
| CPU = hhhh:mm:ss.cc        | Elapsed CPU time                 |
| BUFIO = nnnn               | Count of buffered I/O operations |
| DIRIO = nnnn               | Count of direct I/O operations   |
| PAGEFAULTS = nnnn          | Count of page faults             |

Any one or all five statistics can be written to SYS\$OUTPUT or passed to your user-supplied action routine for other processing.

## LIB\$ Routines

### LIB\$SHOW\_TIMER

#### Call Format for an Action Routine

Action routine is a user-supplied routine called by LIB\$SHOW\_TIMER. The action routine is used when you want to write results to anywhere other than SYS\$OUTPUT. The action routine is called only when you specify the **user-action-procedure** argument in the call to LIB\$SHOW\_TIMER.

LIB\$SHOW\_TIMER calls the action routine using this format:

```
user-action-procedure out-str [,user-argument-value]
```

#### out-str

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Fixed-length string containing the statistics requested. The string is formatted exactly as it would be if written to SYS\$OUTPUT. The leading character is blank.

#### user-argument-value

OpenVMS usage: user\_arg  
type: longword (unsigned) (VAX and Alpha systems)  
quadword (unsigned) (Alpha systems)  
access: read only  
mechanism: by reference

A value passed to LIB\$SHOW\_TIMER. The user argument is passed without interpretation to the action routine.

## Condition Values Returned

|              |  |
|--------------|--|
| SS\$_NORMAL  | Routine successfully completed.  |
| LIB\$_INVARG | Invalid argument. Either <b>code</b> or <b>handle-address</b> was invalid. |

Any condition values returned by LIB\$PUT\_OUTPUT or your action routine.

## Example

```
PROGRAM SHOW_TIMER(INPUT,OUTPUT);
{+}
{ This Pascal example demonstrates how to use LIB$SHOW_TIMER.
{-}
  VAR
    RETURNED_STATUS : INTEGER;
  [EXTERNAL] FUNCTION LIB$INIT_TIMER(
    HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0
  ) : INTEGER; EXTERNAL;
  [EXTERNAL] FUNCTION LIB$SHOW_TIMER(
    HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0;
    CODE       : INTEGER;
    [IMMEDIATE,UNBOUND]
    ROUTINE ACTION_RTN( OUT_STR : [CLASS S] PACKED ARRAY [L..U:INTEGER] OF CHAR;
                        USER_ARG : INTEGER) := %IMMED 0;
    USER_ARG   : INTEGER := %IMMED 0
  ) : INTEGER; EXTERNAL;
```

## LIB\$ Routines LIB\$SHOW\_TIMER

```
[EXTERNAL] FUNCTION LIB$STOP(
    CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
    FAO_ARGS         : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
) : INTEGER; EXTERNAL;

ROUTINE USER_ACTION_RTN(
    OUT_STR : [CLASS S] PACKED ARRAY [L..U:INTEGER] OF CHAR;
    USER_ARG : INTEGER);

    BEGIN
    WRITELN('User argument is ',USER_ARG:1);
    WRITELN(OUT_STR);
    END;

BEGIN

{+}
{ Call LIB$INIT_TIMER to initialize RTL internal counters.
{-}

RETURNED_STATUS := LIB$INIT_TIMER;
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

{+}
{ Print a line of text to waste time.
{-}

WRITELN('Spend time to acquire elapsed real time and page faults');

{+}
{ Call LIB$SHOW_TIMER to display counters.
{-}

RETURNED_STATUS := LIB$SHOW_TIMER(,0,USER_ACTION_RTN,5);
END.
```

This Pascal program demonstrates how to call LIB\$SHOW\_TIMER. The output generated by this Pascal example is as follows:

```
$ RUN SHOW_TIMER
Spend time to acquire elapsed real time and page faults
User argument is 5
ELAPSED: 0 00:00:00.44 CPU: 0:00:00.04
BUFIO: 1 DIRIO: 0 FAULTS: 18
```

---

## LIB\$SHOW\_VM

### Show Virtual Memory Statistics

The Show Virtual Memory Statistics routine returns the statistics accumulated from calls to LIB\$GET\_VM/LIB\$FREE\_VM and LIB\$GET\_VM\_PAGE/LIB\$FREE\_VM\_PAGE.†

#### Format

LIB\$SHOW\_VM [code] [,user-action-procedure] [,user-specified-argument]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**code**  
OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Code specifying any one of the statistics to be written to SYS\$OUTPUT or passed to an action routine for processing. The **code** argument is the address of a signed longword integer containing the statistic code. This is an optional argument. If the statistic code is omitted or is zero, statistics for values 1, 2, and 3 are returned on one line.

The following values are allowed for the **code** argument:

---

| Value | Statistic   |
|-------|---|
| 0     | Statistics for values 1, 2, and 3 are returned.   |
| 1     | Number of successful calls to LIB\$GET_VM.  |
| 2     | Number of successful calls to LIB\$FREE_VM.   |
| 3     | Number of bytes allocated by LIB\$GET_VM but not yet deallocated by LIB\$FREE_VM.                                 |
| 4     | Statistics for values 5, 6, and 7 are returned.   |
| 5     | Number of calls to LIB\$GET_VM_PAGE.  |
| 6     | Number of calls to LIB\$FREE_VM_PAGE.   |
| 7     | Number of VAX pages or Alpha pagelets allocated by LIB\$GET_VM_PAGE but not yet deallocated by LIB\$FREE_VM_PAGE. |

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

**user-action-procedure**

OpenVMS usage: procedure  
 type: procedure value  
 access: function call (before return)  
 mechanism: by value

User-supplied action routine called by LIB\$SHOW\_VM. By default, LIB\$SHOW\_VM returns statistics to SYS\$OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any place other than SYS\$OUTPUT. The routine returns either a success or failure condition value, which will be returned as the value of LIB\$SHOW\_VM.

For more information on the action routine, see Call Format for an Action Routine in the Description section.

**user-specified-argument**

OpenVMS usage: user\_arg  
 type: longword (unsigned)  
 access: read only  
 mechanism: by value

A 32-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry **user-specified-argument** are copied to the argument list entry for **user-action-procedure**.

**Description**

LIB\$SHOW\_VM returns the statistics accumulated from calls to LIB\$GET\_VM /LIB\$FREE\_VM and LIB\$GET\_VM\_PAGE/LIB\$FREE\_VM\_PAGE. By default, with neither **code** nor **user-action-procedure** specified in the call, LIB\$SHOW\_VM writes a line giving the following information to SYS\$OUTPUT:

```
mmm calls to LIB$GET_VM, nnn calls to LIB$FREE_VM, ppp bytes still allocated
```

Optionally, any one of six statistics can be output to SYS\$OUTPUT and/or the line of information can be passed to a user-specified "action routine" for processing different from the default.

**Call Format for an Action Routine**

The action routine is a user-supplied routine that LIB\$SHOW\_VM calls if you specify the **user-action-procedure** argument in the call to LIB\$SHOW\_VM.

The call format for an action routine is:

```
user-action-procedure resultant-string ,user-specified-argument
```

**resultant-string**

OpenVMS usage: char\_string  
 type: character string  
 access: write only  
 mechanism: by descriptor

Statistics supplied by LIB\$SHOW\_VM. The **resultant-string** argument is the address of a descriptor pointing to an address into which LIB\$SHOW\_VM writes the statistics. The string is formatted exactly as it would be if written to SYS\$OUTPUT. The first character is a blank; carriage-return/line-feed combinations are not included.

## LIB\$ Routines

### LIB\$SHOW\_VM

#### **user-specified-argument**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

The 32-bit value passed to LIB\$SHOW\_VM is passed to the action routine without interpretation. If the **user-specified-argument** argument is omitted in the call to LIB\$SHOW\_VM, a zero is passed by value to the user routine.

### Condition Values Returned

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| LIB\$_INVARG | Invalid arguments. This can be caused by an invalid value for <b>code</b> . |

Any condition values returned by LIB\$PUT\_OUTPUT or your action routine.

## LIB\$SHOW\_VM\_64 (Alpha Only) Show Virtual Memory Statistics

The Show Virtual Memory Statistics routine returns the statistics accumulated from calls to LIB\$GET\_VM\_64/LIB\$FREE\_VM\_64 and LIB\$GET\_VM\_PAGE\_64/LIB\$FREE\_VM\_PAGE\_64.

### Format

LIB\$SHOW\_VM\_64 [code] [,user-action-procedure] [,user-specified-argument]

### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

### Arguments

**code**  
 OpenVMS usage: quadword\_signed  
 type: quadword integer (signed)  
 access: read only  
 mechanism: by reference

Code specifying any one of the statistics to be written to SYS\$OUTPUT or passed to an action routine for processing. The **code** argument is the address of a signed quadword integer containing the statistic code. This is an optional argument. If the statistic code is omitted or is zero, statistics for values 1, 2, and 3 are returned on one line.

The following values are allowed for the **code** argument:

| Value | Statistic  |
|-------|--|
| 0     | Statistics for values 1, 2, and 3 are returned.  |
| 1     | Number of successful calls to LIB\$GET_VM_64.  |
| 2     | Number of successful calls to LIB\$FREE_VM_64.   |
| 3     | Number of bytes allocated by LIB\$GET_VM_64 but not yet deallocated by LIB\$FREE_VM_64.                    |
| 4     | Statistics for values 5, 6, and 7 are returned.  |
| 5     | Number of calls to LIB\$GET_VM_PAGE_64.  |
| 6     | Number of calls to LIB\$FREE_VM_PAGE_64.   |
| 7     | Number of Alpha pagelets allocated by LIB\$GET_VM_PAGE_64 but not yet deallocated by LIB\$FREE_VM_PAGE_64. |

## LIB\$ Routines

### LIB\$SHOW\_VM\_64 (Alpha Only)

#### user-action-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied action routine called by LIB\$SHOW\_VM\_64. By default, LIB\$SHOW\_VM\_64 returns statistics to SYS\$OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any place other than SYS\$OUTPUT. The routine returns either a success or failure condition value, which will be returned as the value of LIB\$SHOW\_VM\_64.

For more information on the action routine, see Call Format for an Action Routine in the Description section.

#### user-specified-argument

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by value

A 64-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry **user-specified-argument** are copied to the argument list entry for **user-action-procedure**.

## Description

LIB\$SHOW\_VM\_64 returns the statistics accumulated from calls to LIB\$GET\_VM\_64/LIB\$FREE\_VM\_64 and LIB\$GET\_VM\_PAGE\_64/LIB\$FREE\_VM\_PAGE\_64. By default, with neither **code** nor **user-action-procedure** specified in the call, LIB\$SHOW\_VM\_64 writes a line giving the following information to SYS\$OUTPUT:

```
mmm calls to LIB$GET_VM_64, nnn calls to LIB$FREE_VM_64, ppp bytes still  
allocated
```

Optionally, any one of six statistics can be output to SYS\$OUTPUT and/or the line of information can be passed to a user-specified "action routine" for processing different from the default.

#### Call Format for an Action Routine

The action routine is a user-supplied routine that LIB\$SHOW\_VM\_64 calls if you specify the **user-action-procedure** argument in the call to LIB\$SHOW\_VM\_64.

The call format for an action routine is:

```
user-action-procedure resultant-string ,user-specified-argument
```

#### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Statistics supplied by LIB\$SHOW\_VM\_64. The **resultant-string** argument is the address of a descriptor pointing to an address into which LIB\$SHOW\_VM\_64 writes the statistics. The string is formatted exactly as it would be if written to SYS\$OUTPUT. The first character is a blank; carriage-return/line-feed combinations are not included.

**LIB\$ Routines**  
**LIB\$SHOW\_VM\_64 (Alpha Only)**

**user-specified-argument**

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by value

The 64-bit value passed to LIB\$SHOW\_VM\_64 is passed to the action routine without interpretation. If the **user-specified-argument** argument is omitted in the call to LIB\$SHOW\_VM\_64, a zero is passed by value to the user routine.

**Condition Values Returned**

|             |   |
|-------------|---|
| SS\$NORMAL  | Routine successfully completed.   |
| LIB\$INVARG | Invalid arguments. This can be caused by an invalid value for <b>code</b> . |

Any condition values returned by LIB\$PUT\_OUTPUT or your action routine.

---

## LIB\$SHOW\_VM\_ZONE

### Return Information About a Zone

The Return Information About a Zone routine returns formatted information about a zone in the 32-bit virtual address space, detailing such information as the zone's name, characteristics, and areas, and then passes the information to the specified or default action routine.†

#### Format

LIB\$SHOW\_VM\_ZONE zone-id [,detail-level] [,user-action-procedure] [,user-arg]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### zone-id

OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier. The **zone-id** argument is the address of an unsigned longword containing this identifier. Use zero to indicate the 32-bit default zone.

##### detail-level

OpenVMS usage: longword\_signed  
type: longword (signed)  
access: read only  
mechanism: by reference

An identifier code specifying the level of detail required by the user. The **detail-level** argument is the address of a signed longword containing this code. The default is minimal information. The following are valid values for **detail-level**:

- 0 **zone-id** and name
- 1 **zone-id**, name, algorithm, flags, and size information
- 2 **zone-id**, name, algorithm, flags, size information, cache information, and area summary
- 3 **zone-id**, name, algorithm, flags, size information, cache information, area summary, and queue validation

##### user-action-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Optional user-supplied action routine called by LIB\$SHOW\_VM\_ZONE. By default, LIB\$SHOW\_VM\_ZONE prints statistics to SYS\$OUTPUT by means of LIB\$PUT\_OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any location other than SYS\$OUTPUT. If **user-action-procedure** fails, LIB\$SHOW\_VM\_ZONE terminates and returns a failure code. Success codes are ignored.

For more information on the action routine, see the Description section.

**user-arg**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

Optional 32-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry **user-arg** are copied to the argument list entry for **user-action-procedure**.

## Description

LIB\$SHOW\_VM\_ZONE returns formatted information about the specified zone and passes it to the action routine. The **detail-level** argument determines the degree of detail of the zone information returned, and this information is formatted into a readable display and passed to either a user action routine or to LIB\$PUT\_OUTPUT.

The action routine is a user-supplied routine that LIB\$SHOW\_VM\_ZONE calls if you specify the **action-routine** argument in the call to LIB\$SHOW\_VM\_ZONE. If you do not specify **action-routine**, the information is passed to LIB\$PUT\_OUTPUT for output to SYS\$OUTPUT. The call format for an action routine is as follows:

action-routine string, user-arg

## Arguments

**string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Information supplied by LIB\$SHOW\_VM\_ZONE. The **string** argument is the address of a descriptor pointing to an address into which LIB\$SHOW\_VM\_ZONE writes the requested information. The string is formatted exactly as it would be if written to SYS\$OUTPUT.

**user-arg**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

The 32-bit value passed to LIB\$SHOW\_VM\_ZONE is passed to the action routine without interpretation. If the **user-arg** argument is omitted in the call to LIB\$SHOW\_VM\_ZONE, a zero is passed by value to the user routine.

If no **zone-id** is specified (0 is passed), the 32-bit default zone is used.

**LIB\$ Routines**  
**LIB\$SHOW\_VM\_ZONE**

You must ensure that you have exclusive access to the zone while information is being displayed. Results are unpredictable and may be inconsistent if another thread of control modifies the zone while this routine is displaying data or scanning control blocks.

While scanning the queues and free lists, this routine may detect errors.

If the lookaside list summary discovers a block improperly linked into the list so that the list appears disjointed, the count of the number of blocks of that particular size will be displayed as asterisks.

Table LIB-7 lists error and warning messages which may be displayed during the lookaside list and area free list scans. The format is:

```
**** ERROR -- error description ****
**** WARNING -- warning description ****
```

**Table LIB-7 LIB\$SHOW\_VM\_ZONE Error and Warning Messages**

| <b>Error Message</b>                              | <b>Description</b>   |
|---|--|
| Invalid block size                                | The size of the block is either not large enough to contain the necessary queue links or is unreasonably large. The size field has been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area. |
| Block not owned by zone                           | The current block is not within a section of the virtual address space controlled by this zone. It is possibly attempting to free a block not originally allocated from this zone.   |
| Block extends past the end of area; truncated     | The end of the block is not in the area from which the block has been allocated. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.                           |
| Block extends into "unallocated" block, truncated | The end of the block extends past the allocated section of the area. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.                                       |
| Current block not completely accessible           | The current block extends into a nonexistent part of the virtual address space. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.                            |
| Back link does not return to previous block       | The back link in a doubly linked list does not point to the previous block.  |
| Forward link does not point to valid address      | The forward link of current block points to a location that is not in the virtual address space.   |
| Free-fill mismatch                                | One of the locations filled when the block was freed has been modified.  |

(continued on next page)

Table LIB-7 (Cont.) LIB\$SHOW\_VM\_ZONE Error and Warning Messages

| Error Message  | Description   |
|--|---|
| Boundary tag mismatch                                      | One of the boundary tags of the block is not valid.   |
| <hr/>  |   |
| Warning  | Description   |
| Forward link of current block may not be valid             | The back link of the block pointed to by the forward link of the current block does not point to the current block.   |
| Block at <i>nnnnnnnn</i> is not accessible                 | The block at location <i>nnnnnnnn</i> could not be accessed and cannot be dumped.   |
| Block truncated to <i>nnnnnnnn</i> bytes to prevent ACCVIO | The block to be dumped extends into the inaccessible part of the address space. The size of the block is reduced so that the block to be dumped fits within the accessible addresses. |

When a block forward link is suspected of pointing to an invalid next block, the information from the next block is replaced by asterisks. The following is a sample error display:

```

**** ERROR -- forward-link does not point to valid address ****
Link Analysis for Current Block:
          Previous   Current   Next
          - - - - - - - - - - - - - - - - - - - -
Block adr   : 0014B270 0014C200 6B6E754A
Forw link (abs): 0014C200 6B6E754A *****
Block size = 32
Block contents:
00000000 00000000 6B6E754A 00000020 ...Junk..... 00000 0014C200
0014B270 00000008 00000000 00000000 .....p2.. 00010 0014C210

```

### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_NOTFOU    | Could not find another VM zone (alternate success status).                                      |
| LIB\$_BADZONE   | Invalid zone. Routine was called with a <b>zone-id</b> that does not represent a valid VM zone. |
| LIB\$_INVARG    | Invalid argument.   |
| LIB\$_INVOPEZON | Invalid operation for zone; invalid use of unspecified user zone action routine.                |
| LIB\$_WRONUMARG | Wrong number of arguments.  |

Any condition value returned by the user-formatted output action routine or LIB\$PUT\_OUTPUT.

# LIB\$ Routines

## LIB\$SHOW\_VM\_ZONE

### Examples

1. #include <lib\$routines.h>

```
main()
{
    long zone_id = 0;
    long detail_level = 1;

    LIB$SHOW_VM_ZONE(&zone_id, &detail_level);
}
```

An example of the output generated by this C program using **detail-level 1** is as follows:

```
Zone Id = 7FB96160, Zone name = "DEFAULT_ZONE"
Algorithm = LIB$K_VM_FIRST_FIT
Flags = 00000020
        LIB$M_VM_EXTEND_AREA
Initial size = 124 pages Current size = 0 pages in 0 areas
Extend size = 128 pages Page limit = None

Requests are rounded up to a multiple of 8 bytes,
naturally aligned on 8 byte boundaries

0 bytes have been freed and not yet reallocated

72 bytes are used for zone and area control blocks, or 100.0% overhead
```

2. #include <descrip.h>
#include <libvmdef.h>
#include <lib\$routines.h>
#include <stdlib.h>

```
main()
{
    long zone_id;
    long algorithm = LIB$K_VM_QUICK_FIT;
    long algorithm_arg = 16;
    long flags = LIB$M_VM_FREE_FILL0 | LIB$M_VM_EXTEND_AREA;
    long detail_level = 3;
    $DESCRIPTOR(zone_name, "Mix of lookaside list and area blocks");
    int i;
#define NUM_BLOCKS 250
    char *blocks[NUM_BLOCKS];
    long sizes[NUM_BLOCKS];

    LIB$CREATE_VM_ZONE(&zone_id, &algorithm, &algorithm_arg, &flags,
        0, 0, 0, 0, 0, 0, /* Omitted arguments */
        &zone_name, 0, 0);

    for (i = 0; i < NUM_BLOCKS; i++)
    {
        sizes[i] = rand() % 300 + 9;
        LIB$GET_VM(&sizes[i], &blocks[i], &zone_id);
    }

    for (i = 0; i < NUM_BLOCKS; i++)
        LIB$FREE_VM(&sizes[i], &blocks[i], &zone_id);

    LIB$SHOW_VM_ZONE(&zone_id, &detail_level);
}
```

**LIB\$ Routines**  
**LIB\$SHOW\_VM\_ZONE**

An example of the output generated by this C program using **detail-level 3** is as follows:

Zone Id = 00045000, Zone name = "Mix of lookaside list and area blocks"

Algorithm = LIB\$K\_VM\_QUICK\_FIT with 16 Lookaside Lists ranging from a minimum blocksize of 8, to a maximum blocksize of 128

Flags = 00000028

LIB\$M\_VM\_FREE\_FILL0  
LIB\$M\_VM\_EXTEND\_AREA

Initial size = 16 pages      Current size = 96 pages in 1 area  
Extend size = 16 pages      Page limit = None

Requests are rounded up to a multiple of 8 bytes,  
naturally aligned on 8 byte boundaries

41512 bytes have been freed and not yet reallocated

312 bytes are used for zone and area control blocks, or 0.6% overhead

Quick Fit Lookaside List Summary:

| List<br>number | Block<br>size | Number of<br>blocks |
|----------------|---------------|---------------------|
| -----          | -----         | -----               |
| 2              | 16            | 7                   |
| 3              | 24            | 4                   |
| 4              | 32            | 4                   |
| 5              | 40            | 6                   |
| 6              | 48            | 5                   |
| 7              | 56            | 6                   |
| 8              | 64            | 6                   |
| 9              | 72            | 5                   |
| 10             | 80            | 6                   |
| 11             | 88            | 3                   |
| 12             | 96            | 8                   |
| 13             | 104           | 9                   |
| 14             | 112           | 9                   |
| 15             | 120           | 5                   |
| 16             | 128           | 10                  |

Area Summary:

| First<br>address | Last<br>address | Pages<br>assigned | Bytes not yet<br>allocated |
|------------------|-----------------|-------------------|----------------------------|
| -----            | -----           | -----             | -----                      |
| 00045800         | 000517FF        | 96                | 7640                       |

Scanning Lookaside Lists in Zone Control Block

Scanning Free List for Area at 00045800

Number of blocks = 62, Min blocksize = 136, Max blocksize = 3160

---

## LIB\$SHOW\_VM\_ZONE\_64 (Alpha Only)

### Return Information About a Zone

The Return Information About a Zone routine returns formatted information about a zone in the 64-bit virtual address space, detailing such information as the zone's name, characteristics, and areas, and then passes the information to the specified or default action routine.

#### Format

LIB\$SHOW\_VM\_ZONE\_64 zone-id [,detail-level] [,user-action-procedure] [,user-arg]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### zone-id

OpenVMS usage: identifier  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier. The **zone-id** argument is the address of an unsigned quadword containing this identifier. Use zero to indicate the 64-bit default zone.

##### detail-level

OpenVMS usage: quadword\_signed  
type: quadword (signed)  
access: read only  
mechanism: by reference

An identifier code specifying the level of detail required by the user. The **detail-level** argument is the address of a signed quadword containing this code. The default is minimal information. The following are valid values for **detail-level**:

- 0 **zone-id** and name
- 1 **zone-id**, name, algorithm, flags, and size information
- 2 **zone-id**, name, algorithm, flags, size information, cache information, and area summary
- 3 **zone-id**, name, algorithm, flags, size information, cache information, area summary, and queue validation

##### user-action-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

Optional user-supplied action routine called by LIB\$SHOW\_VM\_ZONE\_64. By default, LIB\$SHOW\_VM\_ZONE\_64 prints statistics to SYS\$OUTPUT by

## LIB\$ Routines LIB\$SHOW\_VM\_ZONE\_64 (Alpha Only)

means of LIB\$PUT\_OUTPUT. An action routine is useful when you want to return statistics to a file or, in general, to any location other than SYS\$OUTPUT. If **user-action-procedure** fails, LIB\$SHOW\_VM\_ZONE\_64 terminates and returns a failure code. Success codes are ignored.

For more information on the action routine, see the Description section.

### user-arg

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by value

Optional 64-bit value to be passed directly to the action routine without interpretation. That is, the contents of the argument list entry **user-arg** are copied to the argument list entry for **user-action-procedure**.

## Description

LIB\$SHOW\_VM\_ZONE\_64 returns formatted information about the specified zone and passes it to the action routine. The **detail-level** argument determines the degree of detail of the zone information returned, and this information is formatted into a readable display and passed to either a user action routine or to LIB\$PUT\_OUTPUT.

The action routine is a user-supplied routine that LIB\$SHOW\_VM\_ZONE\_64 calls if you specify the **action-routine** argument in the call to LIB\$SHOW\_VM\_ZONE\_64. If you do not specify **action-routine**, the information is passed to LIB\$PUT\_OUTPUT for output to SYS\$OUTPUT. The call format for an action routine is as follows:

action-routine string, user-arg

## Arguments

### string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Information supplied by LIB\$SHOW\_VM\_ZONE\_64. The **string** argument is the address of a descriptor pointing to an address into which LIB\$SHOW\_VM\_ZONE\_64 writes the requested information. The string is formatted exactly as it would be if written to SYS\$OUTPUT.

### user-arg

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by value

The 64-bit value passed to LIB\$SHOW\_VM\_ZONE\_64 is passed to the action routine without interpretation. If the **user-arg** argument is omitted in the call to LIB\$SHOW\_VM\_ZONE\_64, a zero is passed by value to the user routine.

If no **zone-id** is specified (0 is passed), the 64-bit default zone is used.

## LIB\$ Routines

### LIB\$SHOW\_VM\_ZONE\_64 (Alpha Only)

You must ensure that you have exclusive access to the zone while information is being displayed. Results are unpredictable and may be inconsistent if another thread of control modifies the zone while this routine is displaying data or scanning control blocks.

While scanning the queues and free lists, this routine may detect errors.

If the lookaside list summary discovers a block improperly linked into the list so that the list appears disjointed, the count of the number of blocks of that particular size will be displayed as asterisks.

Table LIB-8 lists error and warning messages that may be displayed during the lookaside list and area free list scans. The format is as follows:

```
**** ERROR -- error description ****
**** WARNING -- warning description ****
```

**Table LIB-8 LIB\$SHOW\_VM\_ZONE\_64 Error and Warning Messages**

| Error Message                                     | Description  |
|---|--|
| Invalid block size                                | The size of the block is either not large enough to contain the necessary queue links or is unreasonably large. The size field has been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area. |
| Block not owned by zone                           | The current block is not within a section of the virtual address space controlled by this zone. It may be attempting to free a block not originally allocated from this zone.  |
| Block extends past the end of area; truncated     | The end of the block is not in the area from which the block has been allocated. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.                           |
| Block extends into "unallocated" block, truncated | The end of the block extends past the allocated section of the area. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.                                       |
| Current block not completely accessible           | The current block extends into a nonexistent part of the virtual address space. The size field may have been corrupted. Therefore, the size of the block is reduced so the block to be dumped fits within the area.                            |
| Back link does not return to previous block       | The back link in a doubly linked list does not point to the previous block.  |
| Forward link does not point to valid address      | The forward link of current block points to a location that is not in the virtual address space.   |
| Free-fill mismatch                                | One of the locations filled when the block was freed has been modified.  |

(continued on next page)

**Table LIB-8 (Cont.) LIB\$SHOW\_VM\_ZONE\_64 Error and Warning Messages**

| Error Message  | Description   |
|--|---|
| Boundary tag mismatch                                      | One of the boundary tags of the block is not valid.   |
| <hr/>  |   |
| Warning  | Description   |
| Forward link of current block may not be valid             | The back link of the block pointed to by the forward link of the current block does not point to the current block.   |
| Block at <i>nnnnnnnn</i> is not accessible                 | The block at location <i>nnnnnnnn</i> could not be accessed and cannot be dumped.   |
| Block truncated to <i>nnnnnnnn</i> bytes to prevent ACCVIO | The block to be dumped extends into the inaccessible part of the address space. The size of the block is reduced so that the block to be dumped fits within the accessible addresses. |

When a block forward link is suspected of pointing to an invalid next block, the information from the next block is replaced by asterisks. The following is a sample error display:

```

**** ERROR -- forward-link does not point to valid address ****
Link Analysis for Current Block:
          Previous          Current          Next
          -----          -
Block adr   : 00000001C0000050 00000001C0002040 4B4E556A6B6E754A
Forw link (abs): 00000001C0002040 4B4E556A6B6E754A *****
Block size =      64
Block contents:
4B4E556A 6B6E754A 00000000 00000040 @.....JunkjUNK 00000 00000001C0002040
00000000 00000000 00000000 00000000 ..... 00010 00000001C0002050

```

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_NOTFOU    | Could not find another VM zone (alternate success status).                                      |
| LIB\$_BADZONE   | Invalid zone. Routine was called with a <b>zone-id</b> that does not represent a valid VM zone. |
| LIB\$_INVARG    | Invalid argument.   |
| LIB\$_INVOPEZON | Invalid operation for zone; invalid use of unspecified user zone action routine.                |
| LIB\$_WRONUMARG | Wrong number of arguments.  |

Any condition value returned by the user-formatted output action routine or LIB\$PUT\_OUTPUT.

## LIB\$ Routines

### LIB\$SHOW\_VM\_ZONE\_64 (Alpha Only)

#### Examples

1. #include <lib\$routines.h>

```
main()
{
    __int64 zone_id = 0;
    __int64 detail_level = 1;
    LIB$SHOW_VM_ZONE_64(&zone_id, &detail_level);
}
```

An example of the output generated by this C program using **detail-level 1** is as follows:

```
Zone Id = 000000000020040, Zone name = "DEFAULT_ZONE"
Algorithm = LIB$K_VM_FIRST_FIT
Flags = 00000020
        LIB$M_VM_EXTEND_AREA
Initial size = 124 pages Current size = 0 pages in 0 areas
Extend size = 128 pages Page limit = None
Requests are rounded up to a multiple of 16 bytes,
naturally aligned on 16 byte boundaries
0 bytes have been freed and not yet reallocated
128 bytes are used for zone and area control blocks, or 100.0% overhead
```

2. #include <descrip.h>  
#include <libvmdef.h>  
#include <lib\$routines.h>  
#include <stdlib.h>

```
#pragma pointer_size(long)
main()
{
    __int64 zone_id;
    __int64 algorithm = LIB$K_VM_QUICK_FIT;
    __int64 algorithm_arg = 16;
    __int64 flags = LIB$M_VM_FREE_FILL0 | LIB$M_VM_EXTEND_AREA;
    __int64 detail_level = 3;
    $DESCRIPTOR(zone_name, "Lookaside list and area blocks");
    int i;
#define NUM_BLOCKS 250
    char *blocks[NUM_BLOCKS];
    __int64 sizes[NUM_BLOCKS];
    LIB$CREATE_VM_ZONE_64(&zone_id, &algorithm, &algorithm_arg, &flags,
        0, 0, 0, 0, 0, 0, /* Omitted arguments */
        &zone_name, 0, 0);
    for (i = 0; i < NUM_BLOCKS; i++)
    {
        sizes[i] = rand() % 400 + 17;
        LIB$GET_VM_64(&sizes[i], &blocks[i], &zone_id);
    }
    for (i = 0; i < NUM_BLOCKS; i++)
        LIB$FREE_VM_64(&sizes[i], &blocks[i], &zone_id);
    LIB$SHOW_VM_ZONE_64(&zone_id, &detail_level);
}
```

**LIB\$ Routines**  
**LIB\$SHOW\_VM\_ZONE\_64 (Alpha Only)**

An example of the output generated by this C program using **detail-level 3** is as follows:

```
Zone Id = 00000001C0002000, Zone name = "Lookaside list and area blocks"
Algorithm = LIB$K_VM_QUICK_FIT with 16 Lookaside Lists ranging from
a minimum blocksize of 16, to a maximum blocksize of 256
Flags = 00000028
LIB$M_VM_FREE_FILLO
LIB$M_VM_EXTEND_AREA
Initial size = 16 pages Current size = 112 pages in 1 area
Extend size = 16 pages Page limit = None
Requests are rounded up to a multiple of 16 bytes,
naturally aligned on 16 byte boundaries
56992 bytes have been freed and not yet reallocated
576 bytes are used for zone and area control blocks, or 0.9% overhead
Quick Fit Lookaside List Summary:
```

| List number | Block size | Number of blocks |
|-------------|------------|------------------|
| 2           | 32         | 6                |
| 3           | 48         | 7                |
| 4           | 64         | 7                |
| 5           | 80         | 14               |
| 6           | 96         | 6                |
| 7           | 112        | 12               |
| 8           | 128        | 14               |
| 9           | 144        | 14               |
| 10          | 160        | 7                |
| 11          | 176        | 14               |
| 12          | 192        | 8                |
| 13          | 208        | 9                |
| 14          | 224        | 8                |
| 15          | 240        | 12               |
| 16          | 256        | 10               |

Area Summary:

| First address    | Last address     | Pages assigned | Bytes not yet allocated |
|------------------|------------------|----------------|-------------------------|
| 00000001C0004000 | 00000001C0011FFF | 112            | 352                     |

```
Scanning Lookaside Lists in Zone Control Block
Scanning Free List for Area at 00000001C0004000
Number of blocks = 63, Min blocksize = 272, Max blocksize = 1360
```

## LIB\$SIGNAL

### Signal Exception Condition

The Signal Exception Condition routine generates a signal that indicates that an exception condition has occurred in your program. If a condition handler does not take corrective action and the condition is severe, then your program will exit.

#### Format

LIB\$SIGNAL condition-value [,number-of-arguments] [,FAO-argument...]

#### Returns

None.

#### Arguments

##### condition-value

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by value

OpenVMS 32-bit condition value. The **condition-value** argument is an unsigned longword that contains this condition value.

The *OpenVMS Programming Concepts Manual* explains the format of an OpenVMS condition value.

##### number-of-arguments

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by value

Number of FAO arguments associated with **condition-value**. The optional **number-of-arguments** argument is a signed longword integer that contains this number. If omitted or specified as zero, no FAO arguments follow.

##### FAO-argument

OpenVMS usage: varying\_arg  
type: unspecified  
access: read only  
mechanism: by value

Optional FAO (formatted ASCII output) argument that is associated with the specified condition value.

The *OpenVMS Programming Concepts Manual* explains the message format.

### **condition-value2**

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by value

OpenVMS 32-bit condition value. The optional **condition-value2** argument is an unsigned longword that contains this condition value.

The *OpenVMS Programming Concepts Manual* explains the format of an OpenVMS condition value.

### **number-of-arguments2**

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by value

Number of FAO arguments associated with the condition value. The optional **number-of-arguments2** argument is a signed longword integer that contains this number. If omitted or specified as zero, no FAO arguments follow.

### **FAO-argument2**

OpenVMS usage: varying\_arg  
type: unspecified  
access: read only  
mechanism: by value

Optional FAO (formatted ASCII output) argument that is associated with the specified condition value.

The *OpenVMS Programming Concepts Manual* explains the message format.

## **Description**

Your program calls LIB\$SIGNAL whenever it needs to indicate an exception condition or output a message rather than return a status code to its calling program.

LIB\$SIGNAL examines the primary and secondary exception vectors and then scans the stack, frame by frame, starting at the top of the stack, and calls each condition handler it finds. LIB\$SIGNAL locates stack frames by using each frame's saved frame pointer (FP) to chain back through the stack frames. The *OpenVMS Programming Concepts Manual* provides additional information on this process.

If one of the handlers that LIB\$SIGNAL calls returns a continue code (that is, any success completion code with bit 0 set to 1), LIB\$SIGNAL returns to its caller, which should be prepared to continue execution.

If the handler that LIB\$SIGNAL calls returns a resignal code (that is, any completion code with bit 0 set to 0) LIB\$SIGNAL continues to scan the stack.

If the handler called by LIB\$SIGNAL calls SYS\$UNWIND, control will not return to LIB\$SIGNAL's caller, thus changing the program flow. A handler can also modify the saved copy of R0/R1 in the mechanism vector, changing registers R0 and R1 after the stack has been unwound. If a handler does neither of these

## LIB\$ Routines

### LIB\$SIGNAL

things, then all registers including R0/R1 and the hardware condition codes<sup>1</sup> are preserved.

LIB\$SIGNAL will, if necessary, scan up to 65,536 previous stack frames and then finally examine the last-chance exception vector.

The LIB\$SIGNAL argument list, the program counter (PC) and processor status longword (PSL on VAX systems, PS on Alpha systems) of the caller are appended to build the signal argument vector.

### Condition Values Returned

None.

### Examples

```
1. C+
C This Fortran example program demonstrates the use of
C LIB$SIGNAL.
C
C This program defines SS$... signals and then calls LIB$SIGNAL
C passing the access violation code as the argument.
C-
      INCLUDE '($SSDEF)'
      CALL LIB$SIGNAL ( %VAL(SS$_ACCVIO) )
      END
```

In Fortran, this code fragment signals the standard system message ACCESS VIOLATION.

The output generated by this Fortran program on an OpenVMS Alpha system is as follows:

```
%SYSTEM-F-ACCVIO, access violation, reason mask=10, virtual address=03C00020,
PC=00000000, PS=08000000
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name      routine name      line      rel PC      abs PC
D2$MAIN          D2$MAIN          683       00000010    00000410
```

```
2. ;+
; This VAX MACRO example program demonstrates the use of LIB$SIGNAL
; by forcing an access violation to be signaled.
;-
.EXTRN SS$ ACCVIO ; Declare external symbol
.ENTRY START,0
PUSHL #SS$_ACCVIO ; Condition value symbol
; for access violation
CALLS #1, G^LIB$SIGNAL ; Signal the condition
RET
.END START

      .EXTRN      SS$ ACCVIO          ; Declare external symbol
      PUSHL      #SS$_ACCVIO        ; Condition value symbol
      ; for access violation
      CALLS      #1, LIB$SIGNAL     ; Signal the condition
```

This example shows the equivalent VAX MACRO code. The output generated by this program on a OpenVMS VAX system is as follows:

<sup>1</sup> Not available on OpenVMS Alpha systems.

## LIB\$ Routines LIB\$SIGNAL

```
%SYSTEM-F-ACCVIO, access violation, reason mask=0F, virtual address=03C00000,
PC=00000000, PSL=00000000
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name      routine name      line      rel PC      abs PC
.MAIN.           START              0000000F  0000020F
```

```
3. #include <ssdef.h>
   #include <lib$routines.h>

   main()
   {
       /*
       ** lib$signal will append the PC/PS to argument list,
       ** so pass only first two FAO arguments to lib$signal
       */

       lib$signal(SS$ ACCVIO, 4, -559038737);    /* Shouldn't return */
       return (SS$_NORMAL);                    /* Exit if it does */
   }
```

This example shows the equivalent C code. The output generated by this program on an OpenVMS Alpha system is as follows:

```
%SYSTEM-F-ACCVIO, access violation, reason mask=04, virtual address=DEADBEEF,
PC=00020034, PS=0000001B
%TRACE-F-TRACEBACK, symbolic stack dump follows
Image Name      Module Name      Routine Name      Line Number      rel PC      abs PC
LIB$SIGNAL      0 00010034      00020034
LIB$SIGNAL      0 000100A0      000200A0
LIB$SIGNAL      0 82F01158      82F01158
LIB$SIGNAL      0 7FF190D0      7FF190D0
```

---

## LIB\$SIG\_TO\_RET

### Signal Converted to a Return Status

The Signal Converted to a Return Status routine converts any signaled condition value to a value returned as a function. The signaled condition is returned to the caller of the user routine that established the handler that is calling LIB\$SIG\_TO\_RET. This routine may be established as or called from a condition handler.

#### Format

LIB\$SIG\_TO\_RET signal-arguments ,mechanism-arguments

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### signal-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Signal argument vector. The **signal-arguments** argument contains the address of an array that is this signal argument vector stack.

See the *OpenVMS Programming Concepts Manual* for a description of the signal argument vector.

##### mechanism-arguments

OpenVMS usage: structure  
type: unspecified  
access: read only  
mechanism: by reference

Mechanism arguments vector. The **mechanism-arguments** argument contains the address of a structure that is this mechanism argument vector stack.

See the *OpenVMS Programming Concepts Manual* for a description of the mechanism argument vector.

#### Description

LIB\$SIG\_TO\_RET is called with the argument list that was passed to a condition handler by the OpenVMS Condition Handling Facility. The signaled condition is converted to a value returned to the routine that called the routine that established the handler. That action is performed by unwinding the stack to the caller of the establisher of the condition handler. The condition code is returned as the value in R0. See the *OpenVMS Programming Concepts Manual* for more information on condition handling.

LIB\$SIG\_TO\_RET causes the stack to be unwound to the caller of the routine that established the handler which was called by the signal.

## Condition Values Returned

SS\$\_NORMAL                      Routine successfully completed; SS\$\_UNWIND completed. Otherwise, the error code from SS\$\_UNWIND is returned.

## Example

```

C+
C This Fortran example demonstrates how to use LIB$SIG_TO_RET.
C
C This function subroutine inverts each entry in an array. That is,
C a(i,j) becomes 1/a(i,j). The subroutine has been declared as an integer
C function so that the status of the inversion may be returned. The status
C should be success, unless one of the a(i,j) entries is zero. If one of
C the a(i,j) = 0, then 1/a(i,j) is division by zero. This division by zero
C does not cause a division by zero error, rather, the routine will return
C signal a failure.
C-

      INTEGER*4 FUNCTION FLIP(A,N)
      DIMENSION A(N,N)
      EXTERNAL LIB$SIG TO RET
      CALL LIB$ESTABLISH (LIB$SIG_TO_RET)
      FLIP = .TRUE.

C+
C Flip each entry.
C-

      DO 1 I = 1, N
      DO 1 J = 1, N
1      A(I,J) = 1.0/A(I,J)
      RETURN
      END

C+
C This is the main code.
C-

      INTEGER STATUS, FLIP
      REAL ARRAY_1(2,2),ARRAY_2(3,3)
      DATA ARRAY_1/1,2,3,4/,ARRAY_2/1,2,3,5,0,5,6,7,2/
      CHARACTER*32 TEXT(2),STRING
      DATA TEXT(1)/' This array could be flipped. '//,
1      TEXT(2)/' This array could not be flipped.'//

      STRING = TEXT(1)
      STATUS = FLIP(ARRAY_1,2)
      IF ( .NOT. STATUS) STRING = TEXT(2)
      TYPE '(a)', STRING

      STRING = TEXT(1)
      STATUS = FLIP(ARRAY_2,3)
      IF ( .NOT. STATUS) STRING = TEXT(2)
      TYPE '(a)', STRING

      END

```

This Fortran example program inverts each entry in an array. The output generated by this program is as follows:

```

This array could be flipped.
This array could not be flipped.

```

---

## LIB\$SIG\_TO\_STOP

### Convert a Signaled Condition to a Signaled Stop

The Convert a Signaled Condition to a Signaled Stop routine converts a signaled condition to a signaled condition that cannot be continued.

#### Format

LIB\$SIG\_TO\_STOP signal-arguments ,mechanism-arguments

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### signal-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: unspecified  
access: modify  
mechanism: by reference, array reference

Signal argument vector. The **signal-arguments** argument contains the address of an array that is this signal argument vector stack.

See the *OpenVMS Programming Concepts Manual* for a description of the signal argument vector.

##### mechanism-arguments

OpenVMS usage: structure  
type: unspecified  
access: read only  
mechanism: by reference

Mechanism argument vector. The **mechanism-arguments** argument contains the address of a structure that is this mechanism argument vector stack.

See the *OpenVMS Programming Concepts Manual* for a description of the mechanism argument vector.

#### Description

LIB\$SIG\_TO\_STOP causes a signal to appear as though it had been signaled by a call to LIB\$STOP. When a signal is generated by LIB\$STOP, the severity code is forced to SEVERE and control cannot return to the routine that signaled the condition. LIB\$SIG\_TO\_STOP may be enabled as a condition handler for a routine or it may be called from a condition handler.

If the condition value in **signal-arguments** is SS\$\_UNWIND, then LIB\$SIG\_TO\_STOP returns the error condition LIB\$\_INVARG.

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed; SS\$\_UNWIND completed. Otherwise, the error code from SS\$\_UNWIND is returned.

LIB\$\_INVARG

Invalid argument. The condition code in **signal-arguments** is SS\$\_UNWIND.

---

## LIB\$SIM\_TRAP

### Simulate Floating Trap

The Simulate Floating Trap routine converts floating faults to floating traps. It can be enabled as a condition handler or can be called by one.†

**Alpha**

This routine is not available to native OpenVMS Alpha programs but is available to translated VAX images. ♦

#### Format

LIB\$SIM\_TRAP signal-arguments ,mechanism-arguments

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### signal-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: unspecified  
access: modify  
mechanism: by reference, array reference

Signal argument vector. The **signal-arguments** argument contains the address of an array that is this signal argument vector stack.

See the *OpenVMS Programming Concepts Manual* for a description of the signal argument vector.

##### mechanism-arguments

OpenVMS usage: vector\_longword\_unsigned  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Mechanism argument vector. The **mechanism-arguments** argument contains the address of an array that is this mechanism argument vector stack.

See the *OpenVMS Programming Concepts Manual* for a description of the mechanism argument vector.

#### Description

LIB\$SIM\_TRAP converts floating faults to floating traps. It can be enabled as a condition handler or can be called by one.

LIB\$SIM\_TRAP intercepts floating overflow, underflow, and divide-by-zero faults. It simulates the instruction causing the condition up to the point where a fault should be signaled, then signals the corresponding floating trap.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Since LIB\$SIM\_TRAP nullifies the condition handling for the original fault condition, the final condition signaled by the routine will be from the context of the instruction itself, rather than from the condition handler. The signaling path is identical to that of a hardware-generated trap. The signal argument vector is placed so the last entry in the vector will be the user's stack pointer at the completion of the instruction (for a trap), or at the beginning of the instruction (for a fault).

See the *VAX Architecture Reference Manual* for more information on faults and traps.

### **Condition Values Returned**

SS\$\_RESIGNAL

Resignal condition to next handler. The exception was one that LIB\$SIM\_TRAP could not handle.

## LIB\$SKPC

### Skip Equal Characters

The Skip Equal Characters routine compares each character of a given string with a given character and returns the relative position of the first nonequal character as an index. LIB\$SKPC makes the VAX SKPC instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$SKPC character-string ,source-string

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

The relative position in the source string of the first unequal character. LIB\$SKPC returns a zero if the source string was of zero length or if every character in **source-string** was equal to **character-string**.

#### Arguments

##### **character-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String whose initial character is to be used by LIB\$SKPC in the comparison. The **character-string** argument contains the address of a descriptor pointing to this string. Only the first character of **character-string** is used, and the length of **character-string** is not checked.

##### **source-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String to be searched by LIB\$SKPC. The **source-string** argument contains the address of a descriptor pointing to this string.

#### Description

LIB\$SKPC compares the initial character of **character-string** with successive characters of **source-string** until it finds an inequality or reaches the end of the **source-string**. It returns the relative position of this unequal character as an index, which is the relative position of the first occurrence of a substring in the source string.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## Condition Values Returned

None.

## Example

```
C+
C This Fortran example program shows the use of LIB$SKPC.
C LIB$SKPC compares each character of a given string with a given character.
C It returns the relative position of the first nonequal character as an index.
C-
```

```
      I = LIB$SKPC (' ', ' ABC')
      TYPE 1, I
1  FORMAT(' The blank character matches the',I2,'nd character in')
      TYPE *, 'the string " ABC"'
      J = LIB$SKPC ('A', 'AAA')
      TYPE 2, J
2  FORMAT(' The character "A" matches the',I2,'th character in')
      TYPE *, 'the string " AAA"'
      END
```

This Fortran example generates the following output:

```
The blank character matches the 2nd character in
the string " ABC"
The character "A" matches the 0th character in
the string " AAA"
```

---

## LIB\$SPANC

### Skip Selected Characters

The Skip Selected Characters routine is used to skip a specified set of characters in the source string. LIB\$SPANC makes the VAX SPANC instruction available as a callable routine.<sup>1</sup>

#### Format

LIB\$SPANC source-string ,table-array ,byte-integer-mask

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

The relative position in the source string of the character that terminated the operation is returned if such a character is found. Otherwise, zero is returned. If the source string has a zero length, then a zero is returned.

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string used by LIB\$SPANC to index into **table-array**. The **source-string** argument contains the address of a descriptor pointing to this source string.

##### table-array

OpenVMS usage: vector\_mask\_byte  
type: byte (unsigned)  
access: read only  
mechanism: by reference, array reference

Table that LIB\$SPANC indexes into and performs an AND operation with the **byte-integer-mask** byte. The **table-array** argument contains the address of an unsigned byte array that is this table.

##### byte-integer-mask

OpenVMS usage: mask\_byte  
type: byte (unsigned)  
access: read only  
mechanism: by reference

Mask that an AND operation is performed with bytes in **table-array**. The **byte-integer-mask** argument contains the address of an unsigned byte that is this mask.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## Description

LIB\$SPANC uses successive bytes of the string specified by **source-string** to index into a table. An AND operation is performed on the byte selected from the table and the mask byte.

The operation is terminated when the result of the AND operation is zero.

## Condition Values Returned

None.

## Example

```

!+
! This Fortran program demonstrates how to use
! LIB$SCANC and STR$UPCASE.
!
! Declare the Run-Time Library routines to be used.
!-
      INTEGER*4 STR$UPCASE      ! Translate to upper case
      INTEGER*4 LIB$SCANC      ! Look for characters
      INTEGER*4 LIB$SPANC      ! Skip over characters

!+
! Declare the alphabet from which "words" are constructed.
!-
      CHARACTER*(38) ALPHABET
      DATA ALPHABET /'ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789$_'/

!+
! Local variable declarations
!-
      INTEGER*4 WORD_COUNT /0/      ! Count of words found
      INTEGER*4 WORD_LENGTH /0/     ! Length of a word
      INTEGER*4 TOTAL_LENGTH /0/    ! Sum of word lengths
      INTEGER*4 START_POS /0/       ! Position of start of word
      INTEGER*4 END_POS /0/         ! Position of end of word
      REAL*4 AVERAGE_LENGTH /0.0/  ! Average length of words
      CHARACTER*80 LINE             ! Line to examine for words
      BYTE MATCH_TABLE(0:255) /256*0/ ! Match table for scanning

!+
! The routines LIB$SCANC and LIB$SPANC require a table with an entry
! for each possible character. Create a match table from ALPHABET
! with an entry of 1 if the character is in ALPHABET, 0 otherwise.
! MATCH_TABLE has already been initialized to zeros.
!-
      DO I = 1, LEN(ALPHABET)
        MATCH_TABLE(ICHAR(ALPHABET(I:I))) = 1
      END DO

!+
! Loop forever finding words in LINE. When LINE is exhausted,
! indicated by a START_POS of zero, read another one. Upon
! end-of-file, leave the loop and print the statistics.
!-

```

## LIB\$ Routines LIB\$SPANC

```

OPEN( UNIT = 1, FILE = 'TEST.DAT', TYPE = 'OLD' )
DO WHILE (.TRUE.)
  DO WHILE (START_POS .EQ. 0)    ! Get a new line
    READ (1, '(A)', END=900) LINE ! If EOF, skip to 900
    CALL STR$UPCASE (LINE, LINE) ! Convert to upper
                                ! case for matching
    START_POS = LIB$SCANC (LINE, MATCH_TABLE, 1) ! Find beginning
    END DO                                ! of first word

!+
! START_POS now points to the beginning of a word. Call LIB$SPANC to
! find the first character that is not part of the word. Set
! START_POS to beginning of next word. If LIB$SPANC does not
! find a non-word character, it returns zero.
!-

    END_POS =
1    START_POS + LIB$SPANC (LINE(START_POS:), MATCH_TABLE, 1) - 1
    IF (END_POS .LT. START_POS) THEN ! Word goes to end of line
      WORD_LENGTH = (LEN(LINE) + 1) - START_POS
      START_POS = 0 ! Indicate line exhausted
    ELSE
      WORD_LENGTH = END_POS - START_POS
      START_POS =
1    END_POS + LIB$SCANC (LINE(END_POS:), MATCH_TABLE, 1) - 1
      IF (START_POS .LT. END_POS) START_POS = 0 ! No more words on line
    END IF

!+
! Update count and length statistics.
!-

    WORD_COUNT = WORD_COUNT + 1
    TOTAL_LENGTH = TOTAL_LENGTH + WORD_LENGTH
    END DO

900    CONTINUE

!+
! Compute average word length and display statistics.
!-

    IF (WORD_COUNT .NE. 0)
1    AVERAGE_LENGTH = FLOAT(TOTAL_LENGTH) / FLOAT(WORD_COUNT)
    TYPE 901, WORD_COUNT, AVERAGE_LENGTH
901    FORMAT (1X, I10, ' words found, average length was ',
1          F4.1, ' letters.')

    CLOSE (1)

    END

```

This Fortran program reads text from the default input unit and looks for words. A word is defined as a string containing only the characters A through Z (uppercase or lowercase), 0 through 9, and the dollar sign (\$) and underscore (\_) symbols. The program reports the total number of words found and their average length.

The program uses three Run-Time Library routines: STR\$UPCASE, LIB\$SCANC, and LIB\$SPANC.

1. The string is converted to uppercase using STR\$UPCASE so that the search for words will ignore the case of letters.
2. LIB\$SCANC searches through the string for one of a set of characters, the set being specified as nonzero elements in a 256-byte table.
3. Similarly, LIB\$SPANC uses the VAX SPANC instruction to search through a string for a character whose table entry is not zero.<sup>1</sup>

The value returned by each routine is the index into the string where the first matching (or nonmatching) character was found, or zero if no match was found.

The output generated by this Fortran program is as follows:

12 words found, average length was 4.2 letters.

---

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$SPAWN

### Spawn Subprocess

The Spawn Subprocess routine requests the command language interpreter (CLI) of the calling process to spawn a subprocess for executing CLI commands. LIB\$SPAWN provides the same function as the DCL SPAWN command.

#### Format

```
LIB$SPAWN [command-string] [,input-file] [,output-file] [,flags] [,process-name] [,process-id]
           [,completion-status-address] [,byte-integer-event-flag-num] [,AST-address]
           [,varying-AST-argument] [,prompt-string] [,cli] [,table]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### command-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

CLI command to be executed by the spawned subprocess. The **command-string** argument is the address of a descriptor pointing to this CLI command string. If **command-string** is omitted, commands are taken from the file specified by **input-file**.

##### input-file

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Equivalence name to be associated with the logical name SYS\$INPUT in the logical name table for the subprocess. The **input-file** argument is the address of a descriptor pointing to this equivalence string. If **input-file** is omitted, the default is the caller's SYS\$INPUT.

##### output-file

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Equivalence name to be associated with the logical names SYS\$OUTPUT and SYS\$error in the logical name table for the subprocess. The **output-file** argument is the address of a descriptor pointing to this equivalence string. If **output-file** is omitted, the default is the caller's SYS\$OUTPUT.

**flags**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Flag bits that designate optional behavior. The **flags** argument is the address of an unsigned longword that contains these flag bits. By default, all flags are clear.

These flags are defined as follows:

| Bit | Symbol    | Meaning  |
|-----|-----------|--|
| 0   | NOWAIT    | If this bit is set, the calling process continues executing in parallel with the subprocess. If this bit is clear, the calling process hibernates until the subprocess completes.  |
| 1   | NOCLISYM  | If this bit is set, the spawned subprocess does not inherit CLI symbols from its caller. If this bit is clear, the subprocess inherits all currently defined CLI symbols. You may want to specify NOCLISYM to help prevent commands redefined by symbol assignments from affecting the spawned commands.                           |
| 2   | NOLOGNAM  | If this bit is set, the spawned subprocess does not inherit process logical names from its caller. If this bit is clear, the subprocess inherits all currently defined process logical names. You may want to specify NOLOGNAM to help prevent commands redefined by logical name assignments from affecting the spawned commands. |
| 3   | NOKEYPAD  | If this bit is set, the keypad symbols and state are not passed to the subprocess. If this bit is not set, the keypad settings are passed to the subprocess.   |
| 4   | NOTIFY    | If this bit is set, a message is broadcast to SYS\$OUTPUT when the subprocess completes or aborts. If this bit is not set, no message is broadcast. This bit should not be set unless the NOWAIT bit is also set.  |
| 5   | NOCONTROL | If this bit is set, no carriage-return/line-feed is prefixed to any prompt string. If this bit is not set, a carriage-return/line-feed is prefixed to any prompt string specified.   |
| 6   | TRUSTED   | If this bit is set, it indicates a SPAWN command on behalf of the application. If this bit is not set, it indicates that the SPAWN command originates from user. SPAWN commands originating from users are disallowed in captive accounts (DCL).   |
| 7   | AUTHPRIV  | If this bit is set, the subprocess inherits the caller's authorized privileges. If this bit is clear, the spawned processes' authorized mask is set equal to the caller's current (active) privilege mask.   |
| 8   | SUBSYSTEM | If this bit is set, a spawned process inherits protected subsystem IDs for the duration of LOGINOUT.EXE (used to map the CLI). The IDs will be removed in the process of transferring control to the CLI (as a user mode \$RUNDWN is performed). If this bit is clear, LOGINOUT does not execute under the subsystem IDs.          |

## LIB\$ Routines

### LIB\$SPAWN

Bits 9 through 31 are reserved for future expansion and must be zero. Symbolic flag names are defined in Digital-supplied libraries in module \$CLIDEF. They are `CLI$M_NOWAIT`, `CLI$M_NOCLISYM`, `CLI$M_NOLOGNAM`, `CLI$M_NOKEYPAD`, `CLI$M_NOTIFY`, `CLI$M_NOCONTROL`, `CLI$M_TRUSTED`, `CLI$M_AUTHPRIV`, and `CLI$M_SUBSYSTEM`.

#### **process-name**

OpenVMS usage: `process_name`  
type: character string  
access: read only  
mechanism: by descriptor

Name defined for the subprocess. The **process-name** argument is the address of a descriptor pointing to this name string. If **process-name** is omitted, a unique process name will be generated. If you supply a name and it is not unique, LIB\$SPAWN will return the condition value `SS$_DUPLNAM`.

#### **process-id**

OpenVMS usage: `process_id`  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Process identification of the spawned subprocess. The **process-id** argument is the address of an unsigned longword that contains this process identification value.

This process identification value is meaningful only if the **NOWAIT flags** bit is set.

#### **completion-status-address**

OpenVMS usage: `address`  
type: address  
access: read only  
mechanism: by value

The final completion status of the subprocess. The **completion-status-address** argument contains the address of the status. The system writes the value of the final completion status of the subprocess into **completion-status-address** when the subprocess completes. If the subprocess returns a status code of 0, the system writes `SS$_NORMAL` into this address.

If the **NOWAIT flags** bit is set, the **completion-status-address** is updated asynchronously when the subprocess completes. Use the **byte-integer-event-flag-num** or **AST-address** arguments to determine when the subprocess has completed. Your program must ensure that the address is still valid when the value is written.

#### **byte-integer-event-flag-num**

OpenVMS usage: `byte_unsigned`  
type: byte (unsigned)  
access: read only  
mechanism: by reference

The number of a local event flag to be set when the spawned subprocess completes. The **byte-integer-event-flag-num** argument is the address of an unsigned byte that contains this event flag number. If **byte-integer-event-flag-num** is omitted, no event flag is set.

Specifying **byte-integer-event-flag-num** is meaningful only if the **NOWAIT flags** bit is set.

#### **AST-address**

OpenVMS usage: procedure  
type: procedure value  
access: call without stack unwinding  
mechanism: by value

Routine to be called by means of an AST when the subprocess completes.

Specifying **AST-address** is meaningful only if the **NOWAIT flags** bit is set.

#### **varying-AST-argument**

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by value

A value to be passed to the AST routine. Typically, the **varying-AST-argument** argument is the address of a block of storage the AST routine will use.

Specifying **varying-AST-argument** is meaningful only if the **NOWAIT flags** bit is set and if **AST-address** has been specified.

#### **prompt-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Prompt string to use in the subprocess. The **prompt-string** argument is the address of a descriptor pointing to this prompt string. If **prompt-string** is omitted, the subprocess uses the same prompt string that the parent process uses.

#### **cli**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File specification for the command language interpreter (CLI) to be run in the subprocess. The **cli** argument is the address of this file specification string's descriptor. The CLI specified must reside in SYS\$SYSTEM with a file type of .EXE, and it must be installed. No directory or file type may be specified. The **cli** argument must be specified in all uppercase characters.

If **cli** is omitted, the subprocess uses the same CLI as the parent process. If **cli** is specified, no context is copied to the subprocess.

#### **table**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File specification for the command tables to be used by the spawned process. The **table** argument is the address of this file specification string's descriptor. The

## LIB\$ Routines

### LIB\$SPAWN

table specified must reside in SYS\$SHARE with a file type of .EXE, and it must be installed.

If **table** is omitted, the subprocess uses the same table as the parent process.

### Description

The subprocess created by LIB\$SPAWN inherits the following attributes from the caller's environment:

- Process logical names
- Global and local CLI symbols
- Default device and directory
- Process privileges
- Process nondeductible quotas
- Current command verification setting

The subprocess does not inherit process-permanent files nor routine or image context.

Though the subprocess inherits the caller's process privileges as its own process privileges, the set of authorized privileges in the subprocess is inherited from the caller's current privileges. If the calling image is installed with elevated privileges, these privileges are not available to the the subprocess until a SET PROCESS/PRIVILEGE command or equivalent SYS\$SETPRV call is performed in the subprocess to enable these privileges.

If the calling image is installed with elevated privileges, it should disable those privileges around the call to LIB\$SPAWN unless the environment of the subprocess is strictly controlled. Otherwise, there is a possibility of a security breach due to elevated privileges accidentally being made available to the user.

If neither **command-string** nor **input-file** is present, command input is taken from the parent terminal. If both **command-string** and **input-file** are present, the subprocess first executes **command-string** and then reads from **input-file**. If only **command-string** is specified, the command is executed, and the subprocess is terminated. If **input-file** is specified, the subprocess is terminated by either a LOGOUT command or an end-of-file.

The subprocess does not inherit process-permanent files nor routine or image context. No LOGIN.COM file is executed.

Unless the NOWAIT **flags** bit is set, the caller's process is put into hibernation until the subprocess finishes. Because the caller's process hibernates in supervisor mode, any user-mode ASTs queued for delivery to the caller are not delivered until the caller reawakes. Control can also be restored to the caller by means of an ATTACH command or by a suitable call to LIB\$ATTACH from the subprocess.

This routine is supported for use only with the DCL command language interpreter. If used when the current CLI is MCR, the error status LIB\$\_NOCLI is returned.

If an image is run directly as a subprocess or as a detached process, there is no CLI present to perform this function. In such cases, the error status LIB\$\_NOCLI is returned.

Programs depending on embedded DCL commands may not function properly when run under other command language interpreters that may be supported by future versions of OpenVMS operating systems.

See the *OpenVMS DCL Dictionary* for a complete description of the SPAWN command.

### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| SS\$_ACCVIO     | Access violation. One of the string arguments to LIB\$SPAWN could not be read, or <b>completion-status-address</b> could not be written.   |
| SS\$_DUPLNAM    | Duplicate process name. If the argument <b>process-name</b> was specified, it duplicated an existing process name. If <b>process-name</b> was omitted, LIB\$SPAWN was unable to create a unique name for the subprocess.         |
| fac\$_xxx       | Other error trying to create subprocess.   |
| LIB\$_INVARG    | Invalid argument. The optional argument <b>flags</b> was specified, and a bit other than bits 0 through 5 was set.   |
| LIB\$_INVSTRDES | Invalid string descriptor. One of the string arguments had an invalid descriptor.  |
| LIB\$_NOCLI     | No CLI present to perform function. The calling process did not have a CLI to perform the function, or the CLI did not support the request type. Note that an image run as a subprocess or detached process does not have a CLI. |

If an error is encountered during subprocess creation, the status value for that error is returned by LIB\$SPAWN.

### Example

```

ISTAT=LIB$SPAWN(,,,CLI$M_NOKEYPAD.....'> ')
IF (.NOT. ISTAT) CALL LIB$STOP(%VAL(ISTAT))

```

This Fortran fragment shows a call to LIB\$SPAWN from within a Fortran program. A subprocess is spawned taking input from SYS\$INPUT and giving output to SYS\$OUTPUT. The keypad state is not passed to the subprocess. A prompt string of ">" is specified for the subprocess.

---

## LIB\$STAT\_TIMER

### Statistics, Return Accumulated Times and Counts

The Statistics, Return Accumulated Times and Counts routine returns to its caller one of five available statistics accumulated since the last call to LIB\$INIT\_TIMER. Unlike LIB\$SHOW\_TIMER, which formats the values for output, LIB\$STAT\_TIMER returns the value as an unsigned longword or quadword.

#### Format

LIB\$STAT\_TIMER code ,value-argument [,handle-address]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**code**  
OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Code which specifies the statistic to be returned. The **code** argument contains the address of a signed longword integer that is this code. It must be an integer from 1 to 5.

The following values are allowed for **code**.

| Value | Statistic Returned                                |
|-------|---|
| 1     | Elapsed time (quadword, in system time format)    |
| 2     | CPU time (longword, in 10 millisecond increments) |
| 3     | Buffered I/O (longword)                           |
| 4     | Direct I/O (longword)                             |
| 5     | Page faults (longword)                            |

**value-argument**  
OpenVMS usage: user\_arg  
type: unspecified  
access: write only  
mechanism: by reference

The statistic returned by LIB\$STAT\_TIMER. The **value-argument** argument contains the address of a longword or quadword that is this statistic. All statistics are longword integers except elapsed time, which is a quadword.

See the *OpenVMS System Services Reference Manual* for more details on the system time format.

**handle-address**

OpenVMS usage: address  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Pointer to a block of storage. The optional **handle-address** argument contains the address of an unsigned longword that is this pointer.

If **handle-address** is specified, LIB\$STAT\_TIMER assumes that LIB\$INIT\_TIMER has been called with the same value of **handle-address**. **Handle-address** is an optional argument. If it is not specified, LIB\$STAT\_TIMER uses internal storage.

**Description**

Only one of the five statistics is returned by each call to LIB\$STAT\_TIMER. The elapsed time is returned in the system quadword format. Therefore the receiving area should be eight bytes long. All other returned values are longwords.

LIB\$SHOW\_TIMER and LIB\$STAT\_TIMER are relatively simple tools for testing the performance of a new application. Note that LIB\$INIT\_TIMER must be called prior to any calls to LIB\$SHOW\_TIMER or LIB\$STAT\_TIMER.

To obtain more detailed information, use LIB\$GETJPI (Get Job/Process Information) or the OpenVMS system service SYS\$GETTIM (Get Time).

The following summary shows the differences between LIB\$SHOW\_TIMER and LIB\$STAT\_TIMER:

| Code | Statistic                        | Format for LIB\$SHOW_TIMER | Format for LIB\$STAT_TIMER            |
|------|----------------------------------|----------------------------|---------------------------------------|
| 1    | Elapsed real time                | <i>hhhh:mm:ss.cc</i>       | Quadword in system time format        |
| 2    | Elapsed CPU time                 | <i>hhhh:mm:ss.cc</i>       | Longword in 10-millisecond increments |
| 3    | Count of buffered I/O operations | <i>nnnn</i>                | Longword                              |
| 4    | Count of direct I/O operations   | <i>nnnn</i>                | Longword                              |
| 5    | Count of page faults             | <i>nnnn</i>                | Longword                              |

When you call LIB\$INIT\_TIMER, you must use the optional **handle-address** argument only if you want to keep several sets of statistics simultaneously. This argument points to a block in heap storage where the statistics are to be stored.

You need to call LIB\$FREE\_TIMER only if you have specified **handle-address** in LIB\$INIT\_TIMER and you want to deallocate all heap storage resources. In most cases, the implicit deallocation at program exit time will be sufficient.

# LIB\$ Routines

## LIB\$STAT\_TIMER

### Condition Values Returned

|              |   |
|--------------|---|
| SS\$_NORMAL  | Routine successfully completed.   |
| LIB\$_INVARG | Invalid argument. Either <b>code</b> or <b>handle-address</b> is invalid. |

### Example

```
PROGRAM STAT_TIMER(INPUT,OUTPUT);

{+}
{ This Pascal example program demonstrates the use of
{ LIB$STAT_TIMER.
{-}

  TYPE
    BYTE = [BYTE] 0..255;
    WORD = [WORD] 0..65535;
    QUADWORD SYSTEM TIME = [QUAD] RECORD
      FIRST_LONGWORD : UNSIGNED;
      SECOND_LONGWORD : UNSIGNED;
    END;

  VAR
    ELAPSED_REAL_TIME : QUADWORD SYSTEM TIME;
    ELAPSED_STRING : VARYING [32] OF CHAR;
    PAGE_FAULT_COUNT : UNSIGNED;
    RETURNED_STATUS : UNSIGNED;

  [EXTERNAL] FUNCTION LIB$INIT_TIMER(
    HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0
  ) : INTEGER; EXTERNAL;

  [EXTERNAL] FUNCTION LIB$STAT_TIMER(
    CODE : INTEGER;
    VALUE : [UNSAFE,REFERENCE] PACKED ARRAY [L..U:INTEGER] OF BYTE;
    HANDLE_ADR : [REFERENCE] UNSIGNED := %IMMED 0
  ) : INTEGER; EXTERNAL;

  [EXTERNAL] FUNCTION LIB$STOP(
    CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
    FAO_ARGS : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
  ) : INTEGER; EXTERNAL;

  [EXTERNAL] FUNCTION LIB$SYS ASCTIM(
    OUT_LEN : [REFERENCE] WORD := %IMMED 0;
    VAR_DST_STR : PACKED ARRAY [L..U:INTEGER] OF CHAR;
    USER_TIME : QUADWORD SYSTEM TIME := %IMMED 0;
    CNV_FLG : UNSIGNED := %IMMED 0
  ) : INTEGER; EXTERNAL;

  BEGIN

  {+}
  { Call LIB$INIT_TIMER to initialize RTL internal counters.
  {-}

  RETURNED_STATUS := LIB$INIT_TIMER;
  IF NOT ODD(RETURNED_STATUS)
  THEN
    LIB$STOP(RETURNED_STATUS);

  {+}
  { Print a line of text to waste time.
  {-}

  WRITELN('Spend time to acquire elapsed real time and page faults');
```

## LIB\$ Routines LIB\$STAT\_TIMER

```
{+}
{ Call LIB$STAT_TIMER to retrieve statistics values.
{-}

RETURNED_STATUS := LIB$STAT_TIMER(1,ELAPSED_REAL_TIME);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

RETURNED_STATUS := LIB$STAT_TIMER(5,PAGE_FAULT_COUNT);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

{+}
{ Print the statistics retrieved from LIB$STAT_TIMER.
{-}

WRITELN('Page fault count is ',PAGE_FAULT_COUNT:1);

RETURNED_STATUS := LIB$SYS ASCTIM(
    ELAPSED_STRING.LENGTH,
    ELAPSED_STRING.BODY,
    ELAPSED_REAL_TIME,
    1);
IF NOT ODD(RETURNED_STATUS)
THEN
    LIB$STOP(RETURNED_STATUS);

WRITELN('Elapsed real time is ',ELAPSED_STRING);

END.
```

This Pascal program demonstrates the use of LIB\$STAT\_TIMER. The output generated by this program is as follows:

```
Spend time to acquire elapsed real time and page faults
Page fault count is 22
Elapsed real time is 00:00:00.61
```

---

## LIB\$STAT\_VM

### Return Virtual Memory Statistics

The Return Virtual Memory Statistics routine returns to its caller one of six statistics available from calls to LIB\$GET\_VM/LIB\$FREE\_VM and LIB\$GET\_VM\_PAGE/LIB\$FREE\_VM\_PAGE.† Unlike LIB\$SHOW\_VM, which formats the values for output and displays them on SYS\$OUTPUT, LIB\$STAT\_VM returns the statistic in the **value-argument** argument. Only one of the statistics is returned by each call to LIB\$STAT\_VM.

#### Format

LIB\$STAT\_VM code ,value-argument

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**code**  
OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Code specifying which statistic is to be returned. The **code** argument contains the address of a signed longword integer that is this code.

---

| Code | Statistic  |
|------|--|
| 1    | Number of successful calls to LIB\$GET_VM  |
| 2    | Number of successful calls to LIB\$FREE_VM   |
| 3    | Number of bytes allocated by LIB\$GET_VM but not yet deallocated by LIB\$FREE_VM                                 |
| 5    | Number of calls to LIB\$GET_VM_PAGE  |
| 6    | Number of calls to LIB\$FREE_VM_PAGE   |
| 7    | Number of VAX pages or Alpha pagelets allocated by LIB\$GET_VM_PAGE but not yet deallocated by LIB\$FREE_VM_PAGE |

---

Note that it is invalid to omit **code** or to give a **code** of 0 or 4.

**value-argument**  
OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: write only  
mechanism: by reference

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

Value of the statistic returned by LIB\$STAT\_VM. The **value-argument** argument contains the address of a signed longword integer that is this value.

## Description

LIB\$STAT\_VM returns to its caller one of six available statistics. Unlike LIB\$SHOW\_VM, which formats the values for output, LIB\$STAT\_VM returns the value to a location specified as an argument.

Only one of the six statistics can be returned by one call to LIB\$STAT\_VM. **Code** must be one of six values described for LIB\$SHOW\_VM. A **code** value of 0 or 4 is invalid.

Unlike LIB\$SHOW\_VM, which produces ASCII values for output, LIB\$STAT\_VM returns the value in binary form to a location specified as an argument.

## Condition Values Returned

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_INVARG

Invalid argument. The value of **code** was not one of the values allowed by LIB\$STAT\_VM.

---

## LIB\$STAT\_VM\_64 (Alpha Only)

### Return Virtual Memory Statistics

The Return Virtual Memory Statistics routine returns to its caller one of six statistics available from calls to LIB\$GET\_VM\_64 and LIB\$FREE\_VM\_64, as well as LIB\$GET\_VM\_PAGE\_64 and LIB\$FREE\_VM\_PAGE\_64. Unlike LIB\$SHOW\_VM\_64, which formats the values for output and displays them on SYS\$OUTPUT, LIB\$STAT\_VM\_64 returns the statistic in the **value-argument** argument. Only one of the statistics is returned by each call to LIB\$STAT\_VM\_64.

#### Format

LIB\$STAT\_VM\_64 code ,value-argument

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

**code**  
OpenVMS usage: quadword\_signed  
type: quadword integer (signed)  
access: read only  
mechanism: by reference

Code specifying which statistic is to be returned. The **code** argument contains the address of a signed quadword integer that is this code.

---

| Code | Statistic   |
|------|---|
| 1    | Number of successful calls to LIB\$GET_VM_64  |
| 2    | Number of successful calls to LIB\$FREE_VM_64   |
| 3    | Number of bytes allocated by LIB\$GET_VM_64 but not yet deallocated by LIB\$FREE_VM_64                    |
| 5    | Number of calls to LIB\$GET_VM_PAGE_64  |
| 6    | Number of calls to LIB\$FREE_VM_PAGE_64   |
| 7    | Number of Alpha pagelets allocated by LIB\$GET_VM_PAGE_64 but not yet deallocated by LIB\$FREE_VM_PAGE_64 |

---

Note that it is invalid to omit **code** or to give a **code** of 0 or 4.

**value-argument**  
OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

Value of the statistic returned by LIB\$STAT\_VM\_64. The **value-argument** argument contains the address of a signed quadword integer that is this value.

## Description

LIB\$STAT\_VM\_64 returns to its caller one of six available statistics. Unlike LIB\$SHOW\_VM\_64, which formats the values for output, LIB\$STAT\_VM\_64 returns the value to a location specified as an argument.

Only one of the six statistics can be returned by one call to LIB\$STAT\_VM\_64. The **code** argument must be one of six values described for LIB\$SHOW\_VM\_64. A **code** value of 0 or 4 is invalid.

Unlike LIB\$SHOW\_VM\_64, which produces ASCII values for output, LIB\$STAT\_VM\_64 returns the value in binary form to a location specified as an argument.

## Condition Values Returned

SS\$\_NORMAL

Routine successfully completed.

LIB\$\_INVARG

Invalid argument. The value of **code** was not one of the values allowed by LIB\$STAT\_VM\_64.

## LIB\$STOP

### Stop Execution and Signal the Condition

The Stop Execution and Signal the Condition routine generates a signal that indicates that an exception condition has occurred in your program. Exception conditions signaled by LIB\$STOP cannot be continued from the point of the signal.

#### Format

LIB\$STOP condition-value [,number-of-arguments] [,FAO-argument...]

#### Returns

LIB\$STOP generates a signal and stops execution of the calling program. No condition values are returned.

#### Arguments

##### condition-value

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by value

OpenVMS 32-bit condition value. The **condition-value** argument is an unsigned longword that contains this condition value.

The *OpenVMS Programming Concepts Manual* explains the format of a condition value.

##### number-of-arguments

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by value

Number of FAO arguments associated with **condition-value**. The optional **number-of-arguments** argument is a signed longword integer that contains this number. If omitted or specified as zero, no FAO arguments follow.

##### FAO-argument

OpenVMS usage: varying\_arg  
type: unspecified  
access: read only  
mechanism: by value

Optional FAO (formatted ASCII output) argument that is associated with the specified condition value.

The *OpenVMS Programming Concepts Manual* explains the message format.

## Description

LIB\$STOP is called whenever your program must indicate an exception condition because it is impossible to continue execution or return a status code to the calling program.

LIB\$STOP scans the stack frame by frame, starting with the most recent frame, calling each established handler (see the *OpenVMS Programming Concepts Manual*). LIB\$STOP guarantees that control will not return to the caller.

The LIB\$STOP argument list, the Program Counter (PC) and Processor Status Longword (PSL on OpenVMS VAX systems, PS on OpenVMS Alpha systems) of the caller are appended to build the signal argument vector.

The severity of **condition-value** is forced to SEVERE before each call to a handler.

If any handler attempts to continue by returning a success completion code, the error message ATTEMPT TO CONTINUE FROM STOP is printed and your program exits.

If the handler called by LIB\$STOP in turn calls SYS\$UNWIND, control will not return to LIB\$STOP's caller, thus changing the program flow. A handler can also modify the saved copy of R0/R1 in the mechanism vector, changing registers R0 and R1 after the stack has been unwound. If a handler does neither of these things, then all registers including R0/R1 and the hardware condition codes are preserved.<sup>1</sup>

The only way a handler can prevent the image from exiting after a call to LIB\$STOP is to unwind the stack using the SYS\$UNWIND system service.

## Condition Values Returned

None.

## Example

```
10 EXTERNAL LONG FUNCTION LIB$RESERVE_EF
   DECLARE LONG RET_STATUS

   RET_STATUS = LIB$RESERVE_EF( 2% )
   IF (RET_STATUS AND 1%) = 0% THEN
       CALL LIB$STOP( RET_STATUS BY VALUE )
   END IF

   PRINT "Event flag 2 reserved successfully"

   END
```

This BASIC example program uses LIB\$STOP to stop executing if an error is signaled. This BASIC program tries to reserve an event flag that is not accessible to user programs, thus ensuring that an error will be signaled.

The output generated by this BASIC program is as follows:

```
%LIB-F-EF ALRRES, event flag already reserved
%TRACE-F-TRACEBACK, symbolic stack dump follows
module name      routine name          line      rel PC      abs PC
2822XBLST$MAIN  2822XBLST$MAIN          6          00000044    00000644
```

<sup>1</sup> On Alpha systems, OpenVMS Alpha instructions perform the equivalent operation.

## LIB\$SUBX

### Multiple-Precision Binary Subtraction

The Multiple-Precision Binary Subtraction routine performs subtraction on signed two's complement integers of arbitrary length.

#### Format

LIB\$SUBX minuend-array ,subtrahend-array ,difference-array [,array-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### minuend-array

OpenVMS usage: vector\_longword\_signed  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Minuend; a multiple-precision, signed two's complement integer. The **minuend-array** argument is the address of an array of signed longword integers that contains the minuend.

##### subtrahend-array

OpenVMS usage: vector\_longword\_signed  
type: unspecified  
access: read only  
mechanism: by reference, array reference

Subtrahend; a multiple-precision, signed two's complement integer. The **subtrahend-array** argument is the address of an array of signed longword integers that contains the subtrahend.

##### difference-array

OpenVMS usage: vector\_longword\_signed  
type: unspecified  
access: write only  
mechanism: by reference, array reference

Difference; a multiple-precision, signed two's complement integer result. The **difference-array** argument is the address of an array of signed longword integers that contains the difference.

##### array-length

OpenVMS usage: longword\_signed  
type: longword integer (signed)  
access: read only  
mechanism: by reference

Length in longwords of the arrays to be operated on by LIB\$SUBX. The **array-length** argument contains the address of a signed longword integer that is this length. The **array-length** argument must not be negative. The default length is 2 units.

## Description

LIB\$SUBX performs subtraction on signed two's complement integers of arbitrary length. The integers are located in arrays of longwords. The higher addresses contain the higher-precision parts of the values. The highest-addressed longword contains the sign and 31 bits of precision. The remaining longwords contain 32 bits of precision in each. The number of longwords to be operated on is given by the optional argument, **array-length**. The default length is 2, which corresponds to the OpenVMS quadword data type.

## Condition Values Returned

|              |  |
|--------------|--|
| SS\$_NORMAL  | Routine successfully completed.  |
| SS\$_INTOVF  | Integer overflow. The result is correct, except that the sign bit is lost. |
| LIB\$_INVARG | Invalid argument. Length is negative. The output array is unchanged.       |

## Example

```

C+
C This Fortran example program demonstrates the use of LIB$SUBX.
C-
      INTEGER A(2),B(2),C(2),RETURN
C+
C Let "A" have the value 72057594037927937 = '1000000000000001'x.
C Let "B" have the value 4294967295      = '00000000FFFFFFFF'x.
C-
      A(1) = '00000001'x
      A(2) = '10000000'x
      B(1) = 'FFFFFFFF'x
      B(2) = '00000000'x
C+
C Then "A" - "B" is 72057589742960642.
C-
      RETURN = LIB$SUBX(A,B,C)
      TYPE *, ' '
      TYPE *, 'Let A = 72057594037927937 and B = 4294967295.'
      TYPE *, 'Then C = A - B = 72057589742960642.'
      TYPE 2,C(2),C(1)
2  FORMAT(' 72057589742960642 is represented as ',1H',Z8,Z8,3H'x.)
      TYPE *, 51HThat is, C(2) = '0FFFFFFFF'x and C(1) = '00000002'x.
      END

```

This Fortran example demonstrates how to call LIB\$SUBX. The output generated by this program is as follows:

```

Let A = 72057594037927937 and B = 4294967295.
Then C = A - B = 72057589742960642.
72057589742960642 is represented as ' FFFFFFFF      2'x.
That is, C(2) = '0FFFFFFFF'x and C(1) = '00000002'x.

```

---

## LIB\$SUB\_TIMES

### Subtract Two Quadword Times

The Subtract Two Quadword Times routine subtracts two OpenVMS internal-time-format times.

#### Format

LIB\$SUB\_TIMES time1 ,time2 ,resultant-time

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### time1

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

First time, from which LIB\$SUB\_TIMES subtracts the second time. The **time1** argument is the address of an unsigned quadword containing this time. The **time1** argument must represent a later or equal time or a longer or equal time interval than **time2**. The **time1** argument may be either absolute time or delta time as long as **time2** is of the same type. If **time1** and **time2** are of different types, **time1** must be the absolute time.

##### time2

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Second time, which LIB\$SUB\_TIMES subtracts from the first time. The **time2** argument is the address of an unsigned quadword containing this time. The **time2** argument must represent an earlier or equal time or a shorter or equal time interval than **time1**. The **time2** argument may be either absolute time or delta time as long as **time1** is of the same type. If **time2** and **time1** are of different types, **time2** must be the delta time.

##### resultant-time

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: write only  
mechanism: by reference

The result of subtracting **time2** from **time1**. The **resultant-time** argument is the address of an unsigned quadword containing the result. If both **time1** and **time2** are delta times, then **resultant-time** is a delta time. If both **time1** and **time2** are absolute times, then **resultant-time** is a delta time. If **time1** is an

absolute time and **time2** is a delta time, then **resultant-time** is an absolute time.

## Description

LIB\$SUB\_TIMES subtracts two OpenVMS internal times. The second time, specified by **time2**, is subtracted from **time1**. The following table shows the only combinations of times you can subtract:

| Time1    | Time2    | Subtraction     | Resultant-Time |
|----------|----------|-----------------|----------------|
| delta    | delta    | $time1 - time2$ | delta          |
| absolute | absolute | $time1 - time2$ | delta          |
| absolute | delta    | $time1 - time2$ | absolute       |

Delta times must be less than 10,000 days.

OpenVMS does not allow a delta time to be 0 or negative. Therefore, if **time1** and **time2** are equal, **resultant-time** cannot be 0. Instead, **resultant-time** is represented by .1 of one microsecond (the smallest interval of time recognized by the OpenVMS operating system). This interval is shown as "0 00:00:00.00" when formatted by the standard techniques.

## Condition Values Returned

|                 |                                 |
|-----------------|---------------------------------|
| LIB\$_NORMAL    | Routine successfully completed. |
| LIB\$_IVTIME    | Invalid time.                   |
| LIB\$_NEGTIM    | Negative time computed.         |
| LIB\$_WRONUMARG | Incorrect number of arguments.  |
| LIB\$_INVARGORD | Invalid ordering of arguments.  |

## LIB\$SYS\_ASCTIM

### Invoke \$ASCTIM to Convert Binary Time to ASCII String

The Invoke \$ASCTIM to Convert Binary Time to ASCII String routine calls the system service \$ASCTIM to convert a binary date and time value, returning the ASCII string using the semantics of the caller's string.

#### Format

LIB\$SYS\_ASCTIM [resultant-length] ,time-string [,user-time] [,flags]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Number of bytes written into **time-string**, not counting padding in the case of a fixed-length string. The **resultant-length** argument contains the address of an unsigned word integer that is this number.

If the input string is truncated to the size specified in the **time-string** descriptor, **resultant-length** is set to this size. Therefore, **resultant-length** can always be used by the calling program to access a valid substring of **time-string**.

##### time-string

OpenVMS usage: time\_name  
type: character string  
access: write only  
mechanism: by descriptor

Destination string into which LIB\$SYS\_ASCTIM writes the ASCII time string. The **time-string** argument contains the address of a descriptor pointing to the destination string.

##### user-time

OpenVMS usage: date\_time  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Value that LIB\$SYS\_ASCTIM converts to ASCII string form. The **user-time** argument contains the address of a signed quadword integer that is this value.

If zero or no address is specified, the current system date and time are returned. A positive value represents an absolute time. A negative value represents a delta time. Delta times must be less than 10,000 days.

**flags**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Conversion indicator specifying which date and time fields LIB\$SYS\_ASCTIM should return. The **flags** argument is the address of an unsigned bit mask that contains this conversion indicator.

A value of 1 causes only the hour, minute, second, and hundredths of a second to be returned, depending on the length of the buffer. A value of zero (the default) causes the full date and time to be returned, depending on the length of the buffer.

The results of specifying some possible combinations for the values of the **flags** and **time-string** arguments are shown below:

| Time Value | Time-String Length | Flags Value | Information Returned |
|------------|--------------------|-------------|----------------------|
| Absolute   | 23                 | 0           | Date and time        |
| Absolute   | 12                 | 0           | Date                 |
| Absolute   | 11                 | 1           | Time                 |
| Delta      | 16                 | 0           | Days and time        |
| Delta      | 11                 | 1           | Time                 |

Argument **flags** is passed to LIB\$SYS\_ASCTIM by reference and is changed to value for use by \$ASCTIM.

**Description**

See the *OpenVMS System Services Reference Manual* for a complete description of \$ASCTIM.

**Condition Values Returned**

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Routine successfully completed, but the source string was truncated on copy.   |
| LIB\$_FATERRLIB | Fatal internal error. An internal consistency check has failed. This usually indicates an internal error in the Run-Time Library and should be reported to Digital in a Software Performance Report (SPR). |
| LIB\$_INSVIRMEM | Insufficient virtual memory. Your program has exceeded the image quota for virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.  |
| SS\$_IVTIME     | The specified delta time is greater than or equal to 10,000 days.  |

---

## LIB\$SYS\_FAO

### Invoke \$FAO System Service to Format Output

The Invoke \$FAO System Service to Format Output routine calls \$FAO, returning a string in the semantics you provide. If called with other than a fixed-length string for output, the length of the resultant string is limited to 256 bytes and truncation occurs.

#### Format

LIB\$SYS\_FAO character-string, [resultant-length] ,resultant-string [,directive-argument ,...]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### character-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

ASCII control string, consisting of the fixed text of the output string and FAO directives. The **character-string** argument contains the address of a descriptor pointing to this control string.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the output string. The **resultant-length** argument contains the address of an unsigned word integer that is this length.

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Fully formatted output string returned by LIB\$SYS\_FAO. The **resultant-string** argument contains the address of a descriptor pointing to this output string.

**directive-argument**

OpenVMS usage: varying\_arg  
type: unspecified  
access: read only  
mechanism: unspecified

Directive argument contained in longwords. Depending on the directive, a **directive-argument** argument can be a value to be converted, the address of the string to be inserted, or a length or argument count. The passing mechanism for each of these arguments should be the one expected by the \$FAO system service.

**Description**

See the *OpenVMS System Services Reference Manual* for a complete description of \$FAO.

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| SS\$_BUFFEROVF  | Successfully completed, but the formatted output string overflowed the output buffer and was truncated. |
| LIB\$_STRTRU    | Success, but the source string was truncated on copy.   |
| SS\$_BADPARAM   | An invalid directive was specified in the FAO control string.   |
| LIB\$_INSVIRMEM | Insufficient virtual memory to allocate dynamic string.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.                 |

## LIB\$SYS\_FAOL

### Invoke \$FAOL System Service to Format Output

The Invoke \$FAOL System Service to Format Output routine calls the system service routine \$FAOL, returning the string in the semantics you provide. If called with other than a fixed-length string for output, the length of the resultant string is limited to 256 bytes and truncation occurs.

#### Format

LIB\$SYS\_FAOL character-string [,resultant-length] ,resultant-string ,directive-argument-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### character-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

ASCII control string, consisting of the fixed text of the output string and FAO directives. The **character-string** argument contains the address of a descriptor pointing to this control string.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the output string. The **resultant-length** argument contains the address of an unsigned word integer that is this length.

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Fully formatted output string returned by LIB\$SYS\_FAOL. The **resultant-string** argument contains the address of a descriptor pointing to this output string.

**directive-argument-address**

OpenVMS usage: address  
 type: longword (unsigned)  
 access: read only  
 mechanism: unspecified

Directive arguments. The **directive-argument-address** arguments are contained in an array of unsigned longword directive arguments. Depending on the directive, a **directive-argument-address** argument can be a value to be converted, the address of the string to be inserted, or a length or argument count. The passing mechanism for each of these arguments should be the one expected by the \$FAOL system service.

**Description**

See the *OpenVMS System Services Reference Manual* for a complete description of \$FAOL.

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| SS\$_BUFFEROVF  | Successfully completed, but the formatted output string overflowed the output buffer and was truncated. |
| LIB\$_STRTRU    | Success, but the source string was truncated on copy.   |
| SS\$_BADPARAM   | An invalid directive was specified in the FAO control string.   |
| LIB\$_INSVIRMEM | Insufficient virtual memory to allocate dynamic string.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.                 |

## LIB\$SYS\_FAOL\_64 (Alpha Only)

### Invoke \$FAOL\_64 System Service to Format Output

The Invoke \$FAOL\_64 System Service to Format Output routine calls the system service routine \$FAOL\_64, returning the string in the semantics you provide. If called with other than a fixed-length string for output, the length of the resultant string is limited to 256 bytes and truncation occurs.

#### Format

LIB\$SYS\_FAOL\_64 character-string [,resultant-length] ,resultant-string ,directive-address

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### character-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

ASCII control string, consisting of the fixed text of the output string and FAO directives. The **character-string** argument contains the address of a descriptor pointing to this control string.

##### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the output string. The **resultant-length** argument contains the address of an unsigned word integer that is this length.

##### resultant-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Fully formatted output string returned by LIB\$SYS\_FAOL\_64. The **resultant-string** argument contains the address of a descriptor pointing to this output string.

**directive-argument-address**

OpenVMS usage: address  
type: quadword (unsigned)  
access: read only  
mechanism: unspecified

Directive arguments. The **directive-argument-address** arguments are contained in an array of unsigned quadword directive arguments. Depending on the directive, a **directive-argument-address** argument can be a value to be converted, the address of the string to be inserted, or a length or argument count. The passing mechanism for each of these arguments should be the one expected by the \$FAOL\_64 system service.

**Description**

See the *OpenVMS System Services Reference Manual* for a complete description of \$FAOL\_64.

**Condition Values Returned**

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| SS\$_BUFFEROVF  | Successfully completed, but the formatted output string overflowed the output buffer and was truncated. |
| LIB\$_STRTRU    | Success, but the source string was truncated on copy.   |
| SS\$_BADPARAM   | An invalid directive was specified in the FAO control string.   |
| LIB\$_INSVIRMEM | Insufficient virtual memory to allocate dynamic string.   |
| LIB\$_INVSTRDES | Invalid string descriptor. A string descriptor has an invalid value in its CLASS field.                 |

---

## LIB\$SYS\_GETMSG

### Invoke \$GETMSG System Service to Get Message Text

The Invoke \$GETMSG System Service to Get Message Text routine calls the System Service \$GETMSG and returns a message string into **destination-string** using the semantics of the caller's string.

#### Format

LIB\$SYS\_GETMSG message-id [,message-length] ,destination-string [,flags] [,unsigned-resultant-array]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### message-id

OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Message identification to be retrieved by LIB\$SYS\_GETMSG. The **message-id** argument contains the address of an unsigned longword integer that is this message identification.

##### message-length

OpenVMS usage: word\_unsigned  
type: word integer (unsigned)  
access: write only  
mechanism: by reference

Number of characters written into **destination-string**, not counting padding in the case of a fixed-length string. The **message-length** argument contains the address of an unsigned word integer that is this number.

If the input string is truncated to the size specified in the **destination-string** descriptor, **message-length** is set to this size. Therefore, **message-length** can always be used by the calling program to access a valid substring of **destination-string**.

##### destination-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string. The **destination-string** argument contains the address of a descriptor pointing to this destination string. LIB\$SYS\_GETMSG writes the message that has been returned by \$GETMSG into **destination-string**.

**flags**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by reference

Four flag bits for message content. The **flags** argument is the address of an unsigned longword that contains these flag bits. The default value is a longword with bits 0 through 3 set to 1. The **flags** argument is passed to LIB\$SYS\_GETMSG by reference and changed to value for use by \$GETMSG.

The following table lists the bit numbers, their values, and corresponding descriptions.

| Bit | Value | Description                        |
|-----|-------|------------------------------------|
| 0   | 1     | Include text of message.           |
|     | 0     | Do not include text of message.    |
| 1   | 1     | Include message identifier.        |
|     | 0     | Do not include message identifier. |
| 2   | 1     | Include severity indicator.        |
|     | 0     | Do not include severity indicator. |
| 3   | 1     | Include facility name.             |
|     | 0     | Do not include facility name.      |

**unsigned-resultant-array**

OpenVMS usage: unspecified  
 type: unspecified  
 access: write only  
 mechanism: by reference, array reference

A 4-byte array to receive message-specific information. The **unsigned-resultant-array** argument contains the address of this array.

The contents of this 4-byte array are as follows:

| Byte | Contents               |
|------|------------------------|
| 0    | Reserved               |
| 1    | Count of FAO arguments |
| 2    | User value             |
| 3    | Reserved               |

**Description**

LIB\$SYS\_GETMSG calls the \$GETMSG system service and returns a message string using the semantics of the caller's string. Note that, in order to retrieve a message string for a LIB\$ facility message, you must include the file \$LIBDEF in your program.

See the *OpenVMS System Services Reference Manual* for a more complete description of \$GETMSG.

**LIB\$ Routines**  
**LIB\$SYS\_GETMSG**

**Condition Values Returned**

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| SS\$_BUFFEROVF  | Successfully completed, but the resultant string overflowed the buffer provided and was truncated. |
| SS\$_MSGNOTFND  | Successfully completed, but the message code does not have an associated message on file.          |
| LIB\$_STRTRU    | Successfully completed, but the source string was truncated on copy.                               |
| LIB\$_FATERRLIB | Fatal internal error.  |
| LIB\$_INSVIRMEM | Insufficient virtual memory.   |
| LIB\$_INVSTRDES | Invalid string descriptor.   |

---

## LIB\$TPARSE/LIB\$TABLE\_PARSE

### Table-Driven Finite-State Parser

The Table-Driven Finite State Parser‡ routine is a general-purpose, table-driven parser implemented as a finite-state automaton, with extensions that make it suitable for a wide range of applications. It parses a string and returns a message indicating whether or not the input string is valid.

LIB\$T[ABLE\_]PARSE is called with the address of an argument block, the address of a state table, and the address of a keyword table. The input string is specified as part of the argument block.

The LIB\$ facility supports the following two versions of the Table-Driven Finite State Parser:

LIB\$TPARSE Available on VAX systems.

Alpha

LIB\$TPARSE is available on Alpha systems in translated form. In this form, it is applicable to translated VAX images only. ♦

LIB\$TABLE\_PARSE Available on VAX and Alpha systems.

LIB\$TPARSE and LIB\$TABLE\_PARSE differ mainly in the way they pass arguments to action routines. Subsequent sections describe specific differences.

This manual uses the term LIB\$T[ABLE\_]PARSE when describing concepts that apply to both LIB\$TPARSE and LIB\$TABLE\_PARSE.

### Format

LIB\$TPARSE/LIB\$TABLE\_PARSE argument-block ,state-table ,key-table

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

### Arguments

#### argument-block

OpenVMS usage: unspecified  
type: unspecified  
access: modify  
mechanism: by reference

LIB\$T[ABLE\_]PARSE argument block. The **argument-block** argument contains the address of this argument block.

The LIB\$T[ABLE\_]PARSE argument block contains information about the state of the parse operation. It is a means of communication between LIB\$T[ABLE\_]PARSE and the user's program. It is passed as an argument to all action routines.

---

‡ No support for arguments passed by 64-bit address reference or the use of 64-bit descriptors is planned for LIB\$TPARSE. On Alpha systems, LIB\$TABLE\_PARSE supports arguments passed by 64-bit address reference and the use of 64-bit descriptors.

## LIB\$ Routines

### LIB\$PARSE/LIB\$TABLE\_PARSE

You must declare and initialize the argument block. The LIB\$TABLE\_PARSE Argument Block section describes the argument block in detail. The Defining the Argument Block section illustrates the coding for an argument block declaration and discusses its initialization.

LIB\$TABLE\_PARSE supports two argument blocks:

- A 32-bit argument block that accommodates longword addresses, values, and input tokens on both VAX and Alpha systems.

#### Alpha

On Alpha systems, this argument block also accommodates a numeric token whose binary representation is less than or equal to  $2^{64}$ .♦

- A 64-bit argument block that accommodates quadword addresses, values, and input tokens on Alpha systems.

#### state-table

OpenVMS usage: unspecified  
type: unspecified  
access: read only  
mechanism: by reference

Starting state in the state table. The **state-table** argument is the address of this starting state. Usually, the name appearing as the first argument of the \$INIT\_STATE macro is used.

You must define the state table for your parser. LIB\$TABLE\_PARSE provides macros in the MACRO and BLISS languages for this purpose. The State Table section describes these macros.

#### key-table

OpenVMS usage: unspecified  
type: unspecified  
access: read only  
mechanism: by reference

Keyword table. The **key-table** argument is the address of this keyword table. This name must be the same as that which appears as the second argument of the \$INIT\_STATE macro.

You must only assign a name to the keyword table. The LIB\$TABLE\_PARSE macros allocate and define the table. See the Data Representation and Implementation section for more information about the keyword table.

## Description

The following numbered sections explain in detail how LIB\$TABLE\_PARSE works and how to call it from both the MACRO assembly language and high-level languages:

1. How LIB\$TABLE\_PARSE Works — Describes the data structures used by LIB\$TABLE\_PARSE and how LIB\$TABLE\_PARSE operates on them.
2. Coding and Using a Simple State Table — Shows you how to construct and use a simple state table.
3. Using Advanced LIB\$TABLE\_PARSE Features — Explains how to use subexpressions, abbreviations, action routines, and other advanced features.

4. Data Representation — Includes information of interest to the low-level-language programmer, such as the binary representation of state table data.

## 1. How LIB\$T[ABLE\_]PARSE Works

LIB\$T[ABLE\_]PARSE analyzes an input string according to a set of states and transitions presented in a state table you define. It determines whether the input string is valid according to the rules you define for the input language.

There are three parts to any parsing operation:

- The set of symbol types, or **alphabet**, from which you can choose the vocabulary of your language.

You specify a symbol type for each transition you define. A transition uses its symbol type to specify what constitutes a matching substring from the input string.

LIB\$T[ABLE\_]PARSE recognizes the ASCII character set and provides symbolic names for the most common combinations of ASCII characters, such as alphabetic and alphanumeric strings, OpenVMS symbols, and numbers. See the The Alphabet of LIB\$T[ABLE\_]PARSE section for a list of the symbol types that comprise the LIB\$T[ABLE\_]PARSE alphabet.

- The rules that govern how the alphabet is used—in other words, the language's grammar.

You specify the rules for a language in a state table. A LIB\$T[ABLE\_]PARSE state table lists the possible states for your language. Each state consists of a list of the transitions to other states and the operations to be performed when a transition is executed. See the State Tables section.

- The string to be parsed.

The argument block specifies the input string. It also contains additional information about the state of the parse—how much of the string has not been interpreted, what the current token is, and so forth. See the The LIB\$T[ABLE\_]PARSE Argument Block section.

### 1.1 Overview

Before discussing the alphabet, the state table, and the argument block in detail, this section provides an overview of how these three parts work together.

#### 1.1.1 Evaluating the Input String

LIB\$T[ABLE\_]PARSE evaluates the input string from left to right as it transitions from state to state. For a particular transition in a particular state, it evaluates the beginning of the unprocessed part of the input string against the alphabet symbol type you specify for the transition to determine whether there is a match.

LIB\$T[ABLE\_]PARSE compares each character of the remaining input string, from left to right, against the transition's symbol type until it encounters a character in the input string that does not match. It takes the substring that matches the symbol type and stores a pointer to it in the argument block as the current **token**. In this way, any character in the input string that does not belong to the symbol type's constituent character set effectively becomes a separator.

If LIB\$T[ABLE\_]PARSE finds a match, it executes the transition.

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

If the input string does not match, LIB\$T[ABLE\_]PARSE attempts to match the next transition. It performs the comparison using the transitions in the order in which you define them for the state.

#### 1.1.2 Executing a Transition

When LIB\$T[ABLE\_]PARSE finds a match with a transition, it performs the following steps:

1. Stores a pointer to the current token in the argument block. If the token matches one of the numeric symbol types, it also stores the token's binary representation in the argument block.
2. Calls the action routine, if any, specified by the transition and passes it the argument block and any additional user-specified arguments.  
You can use an action routine to reject a transition. In this case, LIB\$T[ABLE\_]PARSE performs none of the following steps. See the Using Action Routines section for more information.
3. Performs one of the following operations:
  - Stores the mask, if any, specified by the transition in the location specified by the transition.
  - Stores the value of token in the program location specified by the transition.
4. Transfers control to the specified state, if any, or to the next state in the state table.

#### 1.1.3 Exiting LIB\$T[ABLE\_]PARSE

LIB\$T[ABLE\_]PARSE continues to match and execute transitions from state to state until one of the following occurs:

- For a valid match, it executes a user-specified transition to TPA\$\_EXIT at main level. It returns the value SS\$\_NORMAL.
- A transition requests that LIB\$T[ABLE\_]PARSE consider the string invalid by specifying a transition to TPA\$\_FAIL at main level (rather than at the level of a subexpression). LIB\$T[ABLE\_]PARSE returns with the value LIB\$\_SYNTAXERR.  
You can also request a transition to TPA\$\_FAIL from an action routine. The action routine can provide an alternate failure status.
- An error occurs at the main level. The error can be:
  - A syntax error. All transitions in the current state fail to match the remaining input string. LIB\$T[ABLE\_]PARSE returns LIB\$\_SYNTAXERR or an alternate failure status returned by an action routine.
  - A state table format error. One of your state table entries is invalid. LIB\$T[ABLE\_]PARSE returns LIB\$\_INVTYPE.

---

#### Note

---

LIB\$T[ABLE\_]PARSE generates no signals and establishes no condition handler; action routines can signal through LIB\$T[ABLE\_]PARSE back to the calling program.

---

## LIB\$ Routines LIB\$TPARSE/LIB\$TABLE\_PARSE

When LIB\$T[ABLE\_]PARSE cannot successfully parse the entire string, it defines the current token, as follows, and stores it in the argument block before returning:

- If LIB\$T[ABLE\_]PARSE fails to match a transition in the current state, it attempts to define the current token as the beginning of the remaining input string. You can incorporate this token in an error message or use it to determine the logical flow of your program.

LIB\$T[ABLE\_]PARSE attempts to match the characters from the beginning of the remaining input string, one at a time, against the TPA\$\_SYMBOL alphabet symbol type until it encounters a character that does not match. The TPA\$\_SYMBOL symbol type consists of all the characters of the standard OpenVMS symbol constituent set.

- If LIB\$T[ABLE\_]PARSE successfully matches one or more consecutive characters from the input string against TPA\$\_SYMBOL, then the substring that matched TPA\$\_SYMBOL becomes the current token.
- If the first character of the remaining input string does not match TPA\$\_SYMBOL, the first character becomes the current token.
- If LIB\$T[ABLE\_]PARSE matches the symbol type for a transition that specifies TPA\$\_FAIL as the next state, it leaves the token that matched the transition as the current token.

### 1.2 Alphabet of LIB\$T[ABLE\_]PARSE

The LIB\$T[ABLE\_]PARSE alphabet consists of a set of symbol types defined in Table LIB-9. This alphabet includes strings made up of elements of the ASCII character set. It provides all the basic building blocks needed for constructing a grammar using the ASCII character set. The alphabet also includes symbol types that represent the more complex constructions found in programming and command language grammar.

Use the symbols types that comprise the LIB\$T[ABLE\_]PARSE alphabet to define a vocabulary and grammar for your language. For each transition you define, you specify one of the alphabet symbol types. LIB\$T[ABLE\_]PARSE compares the characters at the beginning of the remaining input string with this symbol type of each of the possible transitions. If LIB\$T[ABLE\_]PARSE finds a match, it enters the state specified by that transition.

**Table LIB-9 The Alphabet of LIB\$T[ABLE\_]PARSE**

| Symbol Type | Characters Matched   |
|-------------|--|
| 'x'         | The particular ASCII character. In a state table, it is expressed by enclosing the character in single quotation marks. The character can be any member of the 8-bit ASCII code set. LIB\$T[ABLE_]PARSE does not consider uppercase and lowercase alphabetic characters and codes with different values in bit 7 to be equivalent. |
| TPA\$_ANY   | Any single character.  |

(continued on next page)

**LIB\$ Routines**  
**LIB\$TPARSE/LIB\$TABLE\_PARSE**

**Table LIB-9 (Cont.) The Alphabet of LIB\$[ABLE\_]PARSE**

| Symbol Type   | Characters Matched  |
|---------------|---|
| TPA\$_ALPHA   | Any alphabetic character, which includes the DEC multinational character set.   |
| TPA\$_DIGIT   | Any numeric character, that is, 0 through 9.  |
| TPA\$_STRING  | Any string of one or more alphanumeric characters, that is, uppercase or lowercase A through Z, and the numeric characters 0 through 9. The string can be any length. It is bounded on the right by the first nonalphanumeric character or by the end of the string.  |
| TPA\$_SYMBOL  | Any string of one or more through characters of the standard OpenVMS symbol constituent set, that is, uppercase and lowercase A through Z and all DEC multinational characters, in addition to the dollar sign (\$) and the underscore (_). The string is bounded on the right by some character not in the symbol constituent set (usually a blank) or by the end of the string.   |
| 'keyword'     | <p>The string of characters enclosed in single quotation marks. A keyword can consist of one or more characters of the OpenVMS symbol constituent set, that is, uppercase and lowercase A through Z, the numeric characters 0 through 9, the dollar sign (\$), and the underscore (_). Uppercase and lowercase alphabets are treated as different characters.</p> <p>A state table can contain up to 220 keywords. The keyword is bounded on the right by a character not in the symbol constituent set or by the end of the string. Keywords that are one character in length are expressed in the form 'x*' to distinguish them from the single-character symbol ('x'). They must be differentiated since they are not the same in operation. For example, in the input string AB+C, the single character 'A' would match the first character of this string, whereas the keyword 'A*' would not, since B in the string is in the symbol constituent set.</p> |
| TPA\$_BLANK   | Any string of one or more blanks and/or tabs.   |
| TPA\$_OCTAL   | Any octal number (that is, any string of one or more numeric characters 0 through 7) whose magnitude is less than $2^{32}$ for a 32-bit argument block or less than $2^{64}$ for a 64-bit argument block.   |
| TPA\$_DECIMAL | Any decimal number (that is, any string of one or more numeric characters 0 through 9) whose magnitude is less than $2^{32}$ for a 32-bit argument block or less than $2^{64}$ for a 64-bit argument block.   |

(continued on next page)

**Table LIB-9 (Cont.) The Alphabet of LIB\$[TABLE\_]PARSE**

| Symbol Type        | Characters Matched   |
|--------------------|--|
| TPA\$_HEX          | Any hexadecimal number (that is, any string of one or more numeric characters 0 through 9, A through F) whose magnitude is less than $2^{32}$ for a 32-bit argument block or less than $2^{64}$ for a 64-bit argument block.   |
| ‡TPA\$_OCTAL_64    | Any octal number (that is, any string of one or more numeric characters 0 through 7) whose magnitude is less than $2^{64}$ .   |
| ‡TPA\$_DECIMAL_64  | Any decimal number (that is, any string of one or more numeric characters 0 through 9) whose magnitude is less than $2^{64}$ .   |
| ‡TPA\$_HEX_64      | Any hexadecimal number (that is, any string of one or more numeric characters 0 through 9, A through F) whose magnitude is less than $2^{64}$ .  |
| TPA\$_FILESPEC     | Any string that constitutes a valid OpenVMS file specification. The string is bounded on the right by the first character that either is not a file specification constituent character or would cause the string to violate the syntax rules of a file specification.   |
| TPA\$_NODE         | Matches a full node specification including the double colon (::).   |
| TPA\$_NODE_ACS     | Matches a primary node specification including the access control string, if any, but not the double colon (::).   |
| TPA\$_NODE_PRIMARY | Matches a primary node specification excluding both the access control string, if any, and the double colon (::).  |
| TPA\$_UIC          | Any string that constitutes a valid OpenVMS numerical UIC specification, bounded by square brackets or angle brackets. The binary value of the UIC, converted in octal radix, is placed in the argument block. The wildcard character (*) is permitted in the group and/or member fields; its presence results in that field being set to its largest possible value in the binary representation. |

‡Alpha specific

(continued on next page)

**LIB\$ Routines**  
**LIB\$TPARSE/LIB\$TABLE\_PARSE**

**Table LIB-9 (Cont.) The Alphabet of LIB\$T[ABLE\_]PARSE**

| Symbol Type   | Characters Matched  |       |       |               |               |        |        |      |  |             |  |
|---------------|---|-------|-------|---------------|---------------|--------|--------|------|--|-------------|--|
| TPA\$_IDENT   | <p>Any string that constitutes a valid OpenVMS identifier. Identifiers may be given as numerical UICs according to the rules for TPA\$_UIC, or as alphabetic identifier names that appear in the system's rights database. The binary value of the identifier, converted in either octal or hexadecimal radix or by lookup in the system rights database, is placed in the argument block. Identifiers can be entered in any of the following forms:</p> <table> <tr> <td>[n,m]</td> <td>&lt;n,m&gt;</td> </tr> <tr> <td>[name1,name2]</td> <td>&lt;name1,name2&gt;</td> </tr> <tr> <td>[name]</td> <td>&lt;name&gt;</td> </tr> <tr> <td>name</td> <td></td> </tr> <tr> <td>%Xhex-value</td> <td></td> </tr> </table> | [n,m] | <n,m> | [name1,name2] | <name1,name2> | [name] | <name> | name |  | %Xhex-value |  |
| [n,m]         | <n,m>   |       |       |               |               |        |        |      |  |             |  |
| [name1,name2] | <name1,name2>   |       |       |               |               |        |        |      |  |             |  |
| [name]        | <name>  |       |       |               |               |        |        |      |  |             |  |
| name          |   |       |       |               |               |        |        |      |  |             |  |
| %Xhex-value   |   |       |       |               |               |        |        |      |  |             |  |
| TPA\$_LAMBDA  | <p>You can use a wildcard (*) in place of any occurrence of <i>number</i> or <i>name</i> in an identifier form.</p> <p>The empty string (always matches). As it executes the transition, LIB\$T[ABLE_]PARSE does not remove any characters from the input string. LAMBDA transitions are useful in getting action routines called under otherwise awkward circumstances, providing unconditional GOTOs to link portions of a state table together, and providing default actions in certain cases.</p>  |       |       |               |               |        |        |      |  |             |  |
| TPA\$_EOS     | The end of the input string.  |       |       |               |               |        |        |      |  |             |  |
| state label   | <p>The label of a state that functions as a subexpression. A subexpression is analogous to a subroutine within the state table.</p> <p>The subexpression facility permits complex syntactic constructs that appear in many places in grammar to appear only once in the state table. It also permits a degree of nondeterministic or pushdown parsing with a parser that is otherwise deterministic and finite-state. See the Using Subexpressions section for detailed information about subexpressions and examples of their use.</p>   |       |       |               |               |        |        |      |  |             |  |

**Note**

By default, LIB\$T[ABLE\_]PARSE treats blanks, which are defined to be either spaces or tabs, as though they belong to no symbol type constituent set. Effectively, this makes the blank a separator. LIB\$T[ABLE\_]PARSE begins its next comparison with the first nonblank character following the blanks. If you want LIB\$T[ABLE\_]PARSE to evaluate a blank as it would any other character in the input string, you can set the TPA\$V\_BLANKS

flag in the argument block. The Blanks in the Input String section provides as example of the use of this flag.

---

### 1.3 The State Tables

This section describes state table generation and the set of macros used to construct state tables. The Coding and Using a Simple State Table section explains how to use these macros to construct a state table.

The state table must be set up using either MACRO or BLISS. Everything else, including any action routines, can be coded in the language of your choice. Simply compile the state table separately, then link it with your program.

The body of the state table consists of one or more states, each of which defines one or more transitions to the same or other states. The order in which you define the states and the order in which you define the transitions for each state are important:

- If a transition does not specify a target state, LIB\$T[ABLE\_]PARSE transitions to the state immediately following the current state in the state table.
- For a given state, LIB\$T[ABLE\_]PARSE evaluates the input string against the transitions in the order in which they are defined and executes the first transition it matches.
  - If a state defines more than one transition whose symbol types match overlapping sets of possible tokens, you must code the order of transition definitions carefully within the state. For example, the characters 123 followed by a comma (,) could match TPA\$\_DECIMAL, TPA\$\_OCTAL, TPA\$\_STRING, or one of several other symbol types.
  - In general, it is best to order transitions in order of increasing generality of their symbol types. For example, the TPA\$\_SYMBOL symbol type matches all keyword strings and, in general, LIB\$T[ABLE\_]PARSE never executes a keyword transition that follows a TPA\$\_SYMBOL transition. The following list shows the symbol types in order of increasing generality:

```

'keyword'
'x'
TPA$_EOS
TPA$_ALPHA
TPA$_DIGIT
TPA$_BLANK
TPA$_OCTAL
‡TPA$_OCTAL_64
TPA$_DECIMAL
‡TPA$_DECIMAL_64
TPA$_HEX
‡TPA$_HEX_64
TPA$_STRING
TPA$_SYMBOL
TPA$_UIC
TPA$_IDENT
```

---

‡ Alpha specific

## LIB\$ Routines

### LIB\$PARSE/LIB\$TABLE\_PARSE

TPA\$\_NODE\_PRIMARY  
TPA\$\_NODE\_ACS  
TPA\$\_NODE  
TPA\$\_FILESPEC  
TPA\$\_ANY  
TPA\$\_LAMBDA

---

#### Note

---

The list above does not include subexpression calls. Their placement depends on the symbol types recognized within the subexpression. If you use action routines to reject certain transitions, you can change the order in which that symbol type is placed in this order. In any case, LIB\$T[ABLE\_]PARSE will execute the first transition listed in a state that you permit to match the leftmost portion of the remaining input string.

---

### 1.3.1 MACRO State Table Generation Macro Calls

The OpenVMS system MACRO library contains a set of assembler macros that allow convenient and readable coding of a LIB\$T[ABLE\_]PARSE state table. These macros generate symbol definitions and tables. They do not produce any executable code or routine calls.

There are four MACRO state table generation macros:

- \$INIT\_STATE—Initializes the LIB\$T[ABLE\_]PARSE macros and declares the beginning of a state table
- \$STATE—Defines a state
- \$TRAN—Defines a state transition
- \$END\_STATE—Ends the state table

A state table begins with a call to \$INIT\_STATE and ends with a call to \$END\_STATE. Within the state table, define each state by a call to \$STATE immediately followed by as many calls to \$TRAN as you need to define the transitions from that state.

Sections 1.3.1.1 through 1.3.1.4 define the syntax of each macro.

#### 1.3.1.1 \$INIT\_STATE—Initializes the LIB\$T[ABLE\_]PARSE Macros

The \$INIT\_STATE macro declares the beginning of a state table. It initializes the internals of the table generator macros and declares the locations of the state table and the keyword table:

- The state table is the structure containing the definitions of the states and the transitions between them. LIB\$T[ABLE\_]PARSE builds the state table as it processes the \$STATE and \$TRAN macros you use to define the table.
- The keyword table contains the text of the keywords used in the state table. LIB\$T[ABLE\_]PARSE builds the keyword table as it processes the calls to \$TRAN for each state.

The Data Representation section provides specifics on the allocation and binary representations of the state table and the keyword table. This information may be useful in debugging your program.

`$INIT_STATE state-table ,key-table`

**state-table**

The name assigned to the state table. `LIB$T[ABLE_]PARSE` equates this label to the start of the first state in the state table.

**key-table**

The name assigned to the keyword table. `LIB$T[ABLE_]PARSE` equates this label to the start of the keyword table.

You must supply both the address of the state table and the address of the keyword table in the call to `LIB$T[ABLE_]PARSE` to perform a parse. The `$INIT_STATE` macro can appear more than once in a program. Each occurrence defines a separate state table. No part of any state table can refer to part of any other state table.

**1.3.1.2 \$STATE—Defines a State**

The `$STATE` macro declares the beginning of a state.

`$STATE [label]`

**label**

An optional label for the state. `LIB$T[ABLE_]PARSE` equates the label, if present, to the starting address of the state.

**1.3.1.3 \$STRAN—Defines a State Transition**

The `$STRAN` macro defines a transition from the state in which it is defined to some other (or to the same) state. The arguments of the macro define, among other things, the symbol type that causes the transition to be executed, the state to which to transfer, and the action routine to call, if any. The transition defined by a `$STRAN` macro belongs to the state defined by the last preceding `$STATE` macro.

`$STRAN type [,label] [,action] [,mask] [,msk-adr] [,argument]`

**type**

The symbol type, taken from the `LIB$T[ABLE_]PARSE` alphabet, that is recognized by this transition. The transition is taken if the characters from the beginning of the remaining input string match the specified symbol type.

If the transition calls a subexpression to determine a match, the symbol type syntax includes the state label of the subexpression to be called. It is indicated with the `MACRO` expression `!label`. See the Using Subexpressions section for information about subexpressions.

**label**

The optional target state of this transition. If present, it must be the label assigned to some state in the state table. If no `label` argument is present, `LIB$T[ABLE_]PARSE` transfers control to the state immediately following the current state in the state table.

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

LIB\$T[ABLE\_]PARSE defines two expressions you can also specify as the target state in the **label** argument:

- **TPA\$\_EXIT** — The parsing operation in progress terminates with a success status.
- **TPA\$\_FAIL** — The parsing operation stops with a failure status, as if a syntax error had occurred.

#### **action**

The optional address of a user-supplied action routine. If this argument is present, LIB\$T[ABLE\_]PARSE calls the named action routine before it executes the transition. The Using Action Routines section describes the calling sequence of action routines and the information available to them.

Since the action routine address is self-relative, it cannot be in a shared image separate from the state table.

#### **mask**

An optional 32-bit mask value used with the **msk-adr** argument.

When LIB\$T[ABLE\_]PARSE executes the transition, it performs an inclusive OR operation using the **mask** value and the contents of **msk-adr** and stores the result in **msk-adr**.

You can associate one or more bits in **mask** with a particular transition and set those bits. When LIB\$T[ABLE\_]PARSE returns, you can check the bits in **msk-adr** to determine which transitions were executed. You can also use an action routine to check the bit and ensure that a transition is executed only once.

If the **mask** argument is present, the **msk-adr** argument must also be present.

#### **msk-adr**

The **msk-adr** argument provides two mutually exclusive capabilities depending on whether the **mask** argument is present:

- If **mask** is present, **msk-adr** is the address of a longword associated with the preceding **mask** argument. LIB\$T[ABLE\_]PARSE performs the inclusive OR operation on the contents of this address and the **mask** argument and stores the result in **msk-adr**.

Initialize the contents of **msk-adr** to zero before calling LIB\$T[ABLE\_]PARSE.

- If **mask** is not present, you can use **msk-adr** to specify the address of a location where LIB\$T[ABLE\_]PARSE stores information about the matching token. No OR operation is performed. This capability lets a program extract the most commonly needed information from the input string without using action routines.

The kind of information that LIB\$T[ABLE\_]PARSE stores in the location you specify as the **msk-adr** argument depends on the symbol type specified for the **type** argument and on the argument block, as follows:

- If the symbol type is **TPA\$\_DECIMAL**, **TPA\$\_OCTAL**, or **TPA\$\_HEX**, LIB\$T[ABLE\_]PARSE stores the binary representation of the matching number as an unsigned longword for a 32-bit argument block and as an unsigned quadword for a 64-bit argument block.

## LIB\$ Routines LIB\$TPARSE/LIB\$TABLE\_PARSE

- If the symbol type is TPA\$\_DECIMAL\_64, TPA\$\_OCTAL\_64, or TPA\$\_HEX\_64, LIB\$T[ABLE\_]PARSE stores the binary representation of the matching number as an unsigned quadword for both 32-bit and 64-bit argument blocks.
- If the symbol type is 'x', TPA\$\_ANY, TPA\$\_ALPHA, or TPA\$\_DIGIT, LIB\$T[ABLE\_]PARSE stores the 8-bit matching character as an unsigned byte.
- If the symbol is of any other type, you must specify **msk-adr** as the address of a 32-bit or 64-bit string descriptor, as appropriate, that you allocate in your program. LIB\$T[ABLE\_]PARSE assumes a 32-bit or 64-bit descriptor if the argument block with which you called it is 32-bit or 64-bit, respectively.

For a 32-bit descriptor, LIB\$T[ABLE\_]PARSE stores the length of the token in the first 32 bits (longword) of the descriptor. It stores a pointer to the token in the second longword. This pointer is the address of the token in the input string.

For a 64-bit descriptor, LIB\$T[ABLE\_]PARSE stores the length of the token in the second quadword of the descriptor and stores the address of the token in the input string in the third quadword. On entry, LIB\$T[ABLE\_]PARSE writes the fields of the first quadword as follows:

```
DSC64$B_CLASS = DSC64$K_CLASS_S
DSC64$B_DTYPE = DSC64$K_DTYPE_T
DSC64$L_MBMO = -1
DSC64$W_MBO = +1
```

Using **msk-adr** makes your parsing program nonmodular. The resulting program, which contains this state table, includes code that is not position independent.

Since the address specified by **msk-adr** is self-relative, it cannot be in a shared image separate from the state table.

### **argument**

An optional 32-bit value that LIB\$T[ABLE\_]PARSE passes to the action routine without interpretation. This argument can be an identifier number, an address, or any other information your action routine needs. It allows a single action routine to serve many transitions for which similar, but slightly varying, actions must be performed.

Because LIB\$T[ABLE\_]PARSE does not know the form or meaning of **argument** the value is stored in its absolute form. If you use **argument** to pass an address, you must store the address in its absolute form rather than as a self-relative pointer. In this case the resulting program, which contains this state table, is nonmodular. That is, it includes code that is not position independent.

### 1.3.1.4 \$END\_STATE—Ends the State Table

The \$END\_STATE macro declares the end of the state table. It is mandatory, in order to permit the orderly cleanup of the LIB\$T[ABLE\_]PARSE macro system. The \$END\_STATE macro has no arguments. You code it as follows:

```
$END_STATE
```

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

#### 1.3.2 BLISS State Table Generation Macro Calls

The SYS\$LIBRARY:TPAMAC.L32 and SYS\$LIBRARY:TPAMAC.L64 files each contain a set of BLISS macros that allow convenient and readable coding of LIB\$T[ABLE\_]PARSE state tables in BLISS.

There are two BLISS state table generation macros:

- \$INIT\_STATE—Initializes the macros
- \$STATE—Defines a state and its transitions

To make the macros available to the program, include the following declaration in the module containing the state tables:

```
LIBRARY 'SYS$LIBRARY:TPAMAC';
```

The BLISS compiler you use, BLISS-32 or BLISS-64, chooses the corresponding SYS\$LIBRARY:TPAMAC file.

The BLISS table generation macros contain no BEGIN or END statements. This allows \$STATE macros to refer to each other. They generate all storage with OWN declarations. This means that the macros modify PSECT declarations for OWN and GLOBAL storage. Thus if other data declarations follow the state table declarations, they may not have the correct attributes. You cannot simply surround the state table with BEGIN/END, because this constitutes an expression. No declarations of any kind, including ROUTINE declarations, can follow an expression.

There are four techniques for including LIB\$T[ABLE\_]PARSE state tables in BLISS modules:

- Follow the state table with explicit redeclarations of the OWN and GLOBAL PSECTs. The BLISS example at the end of the LIB\$TPARSE/LIB\$TABLE\_PARSE routine description uses this technique.
- Place the state table in a separate module. The high-level language examples in the next section use this technique.
- Place the state table between BEGIN and END statements after the declarations within a routine body.
- Place the state table between BEGIN and END statements at the end of a module.

In all cases you must define all action routines, masks, addresses, and arguments with suitable declarations (which can be FORWARD or EXTERNAL). The LIB\$T[ABLE\_]PARSE macros handle the necessary FORWARD declarations for forward references to labels within the state table.

Sections 1.3.2.1 and 1.3.2.2 define the syntax of each macro.

##### 1.3.2.1 \$INIT\_STATE—Initializes the LIB\$T[ABLE\_]PARSE Macros

The \$INIT\_STATE macro initializes the LIB\$T[ABLE\_]PARSE macro system in the same manner it does for MACRO.

```
$INIT_STATE (state-table, key-table);
```

**state-table**

The name assigned to the state table. LIB\$T[ABLE\_]PARSE equates this label to the start of the first state in the state table.

**key-table**

The name assigned to the keyword table. LIB\$T[ABLE\_]PARSE equates this label to the start of the keyword table.

Both names are declared as global vectors of length zero. As with the MACRO state table generation macros, you can invoke \$INIT\_STATE more than once to declare several state tables within a single module.

**1.3.2.2 \$STATE—Declares a State and Its Transitions**

In BLISS, you use the \$STATE macro to declare a state in its entirety, including its transitions.

```
$STATE ([label], ( transition ), ( transition ), ( transition ) ...);
```

**label**

Optional address of the start of the state. The compiler declares **label** as a local vector of length zero. Note that the comma following the optional label is mandatory.

**transition**

Each transition appears within parentheses in the same form as the transition argument list for the MACRO \$TRAN macro.

```
type [,label] [,action] [,mask] [,msk-adr] [,argument]
```

The arguments of each transition are expressed in exactly the same format as in the MACRO macros, with the exception of the subexpression symbol type. In BLISS, this symbol type has the form (label).

Note that the transitions are not specified as keyword macros. Therefore, you must use commas to indicate arguments you have skipped.

**1.4 LIB\$T[ABLE\_]PARSE Argument Block**

LIB\$T[ABLE\_]PARSE finds the input string through the argument block. This argument block is the impure data base upon which LIB\$T[ABLE\_]PARSE operates. That is, it is a set of variable data that can be written as well as read. It contains information about the string to be parsed, option flags for LIB\$T[ABLE\_]PARSE, and data about the current token. If LIB\$T[ABLE\_]PARSE calls an action routine, it passes the argument block to the action routine. This permits the action routine efficient reference to relevant data.

**1.4.1 Choosing an Argument Block**

LIB\$T[ABLE\_]PARSE provides an argument block for 32-bit operations on both VAX and Alpha systems. It also provides an argument block for 64-bit operations on Alpha systems.

# LIB\$ Routines

## LIB\$TPARSE/LIB\$TABLE\_PARSE

### 1.4.1.1 32-Bit Argument Block

The 32-bit LIB\$T[ABLE\_]PARSE argument block accommodates longword addresses and values as well as input tokens whose binary representations require no more than 32 bits.

**Alpha**

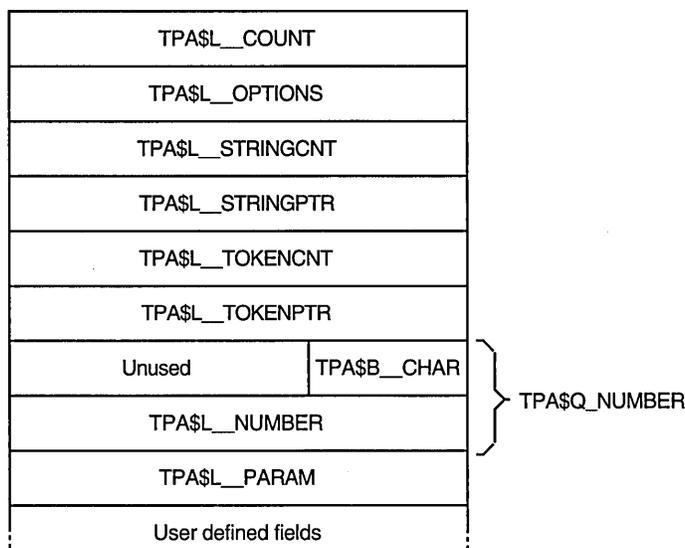
On Alpha systems, the LIB\$T[ABLE\_]PARSE 32-bit argument block can also accommodate a numeric input token whose binary representation requires up to 64 bits. ♦

LIB\$T[ABLE\_]PARSE defines the first 9 longwords of the 32-bit argument block as shown in Figure LIB-20. You must pass an argument block of at least this length as the first argument to LIB\$T[ABLE\_]PARSE. You can add fields to the end of the argument block as a means of passing user-defined data to action routines.

The TPA\$K\_LENGTH0 symbol represents the number of bytes (36) in the basic 32-bit argument block. You can use this symbol to determine the start of any user-defined fields you add to the argument block.

Table LIB-10 describes the argument block fields.

**Figure LIB-20 LIB\$T[ABLE\_]PARSE 32-bit Argument Block**



ZK-1929-GE

### 1.4.1.2 64-Bit Argument Block

**Alpha**

The 64-bit LIB\$T[ABLE\_]PARSE argument block accommodates quadword addresses and values as well as input tokens whose binary representations require no more than 64 bits.

LIB\$T[ABLE\_]PARSE defines the first 10 words of the 64-bit argument block as shown in Figure LIB-21. You can add fields to the end of the argument block as a means of passing data to action routines.

## LIB\$ Routines LIB\$TPARSE/LIB\$TABLE\_PARSE

The TPA64\$K\_LENGTH0 symbol represents the number of bytes (80) in the basic 64-bit argument block. You can use this symbol to determine the start of any user-defined fields you add to the argument block.

Table LIB-10 describes the argument block fields. ♦

**Figure LIB-21 LIB\$T[ABLE\_]PARSE 64-Bit Argument Block (Alpha Only)**

|                     |                |
|---------------------|----------------|
| TPA\$L_OPTIONS      | TPA64\$L_COUNT |
| TPA64\$Q_STRINGDESC |                |
| TPA64\$Q_STRINGCNT  |                |
| TPA64\$Q_STRINGPTR  |                |
| TPA64\$Q_TOKENDESC  |                |
| TPA64\$Q_TOKENCNT   |                |
| TPA64\$Q_TOKENPTR   |                |
| Unused              | TPA64\$B_CHAR  |
| TPA64\$Q_NUMBER     |                |
| TPA64\$Q_PARAM      |                |
| User defined fields |                |

ZK-8085A-GE

### 1.4.2 Symbolic Names for Argument Block Fields

The fields in each type of argument block have symbolic names. Figure LIB-20 and Figure LIB-21 show some of these symbolic names. This section tells you how to access these names in some of the most commonly used languages:

- **MACRO** assembly language — MACRO language programs can define both the 32-bit and 64-bit argument block names by invoking the macro \$TPADEF (automatically loaded from the system macro library). The field names define the byte offset of the field from the start of the argument block. This includes the bit fields (\$V\_names). In addition, bit mask values (\$M\_names) are available for the bit fields.
- **BLISS** — The field names are also available to BLISS programs from the system macro SYS\$LIBRARY:STARLET.L32 and SYS\$LIBRARY:STARLET.L64 libraries. Each name (except for the \$M\_names) is defined as a fixed-reference macro that operates on a byte-based block. The \$M\_names are defined as literals.
- **C** — The same field names are available to C programs from the **tpadef.h** file. For the 32-bit and 64-bit argument blocks, the names are defined as elements of the *tpadef* and *tpa64def* structures, respectively.

See the Defining the Argument Block section for an example of an argument block declaration.

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

#### 1.4.3 32-Bit and 64-Bit Argument Block Fields

Table LIB-10 describes the fields of the 32-bit and 64-bit argument blocks.

Note that most fields have two symbols and one description. The symbol that begins with the prefix TPA\$ is used with a 32-bit argument block, while the symbol that begins with the prefix TPA64\$ is used with a 64-bit argument block. To prevent cumbersome explanations, the following discussion uses only the main part of a field name, without the prefix used in the actual code, when referring to a field for both the 32-bit and 64-bit argument blocks. For example, the options field is referred to as OPTIONS rather than mentioning both TPA\$L\_OPTIONS and TPA64\$L\_OPTIONS. The complete field name is used only when referring to a field for one particular form of argument block.

Table LIB-10 LIB\$T[ABLE\_]PARSE Argument Block Fields

| Symbol                         | Description   |
|--------------------------------|---|
| TPA\$L_COUNT<br>TPA64\$L_COUNT | <p>A longword containing the value of TPA\$K_COUNT0 for 32-bit argument blocks or TPA64\$K_COUNT0 for 64-bit argument blocks. TPA\$K_COUNT0 is defined to be 8. TPA64\$K_COUNT0 is defined to be -1.</p> <p>If the value contained in this longword is greater than or equal to 8, LIB\$T[ABLE_]PARSE treats the argument block as a 32-bit argument block. If the value is -1, LIB\$T[ABLE_]PARSE treats the argument block as a 64-bit argument block.</p> <p>For LIB\$TPARSE (VAX only), a longword containing the number of longwords that make up the rest of the argument block. This longword functions as the argument count when the argument block becomes the argument list to an action routine. This field must contain a value that is greater than or equal to the value of TPA\$K_COUNT0, whose numeric value is 8.</p> |

(continued on next page)

**Table LIB-10 (Cont.) LIB\$T[ABLE\_]PARSE Argument Block Fields**

| Symbol                             | Description  |
|------------------------------------|--|
| TPA\$L_OPTIONS<br>TPA64\$L_OPTIONS | <p>Contains various flag bits and other options. The defined flags are as follows:</p> <ul style="list-style-type: none"> <li>• TPA\$V_BLANKS, TPA64\$V_BLANKS<sup>1</sup> — Setting this bit causes LIB\$T[ABLE_]PARSE to process blanks and tabs explicitly, rather than treating them as separators. See the Blanks in the Input String section for information about processing blanks.</li> <li>• TPA\$V_ABBRFM, TPA64\$V_ABBRFM<sup>1</sup> — Setting this bit allows keywords to be abbreviated to any length. If an abbreviated keyword string is ambiguous, the first eligible transition listed in the state matches it.</li> <li>• TPA\$V_ABBREV, TPA64\$V_ABBREV<sup>1</sup> — Setting this bit allows keywords to be abbreviated to the shortest length that is unambiguous in that state. See the Abbreviating Keywords section.</li> <li>• TPA\$V_AMBIG, TPA64\$V_AMBIG<sup>1</sup> — LIB\$T[ABLE_]PARSE sets this bit when it has detected an ambiguous keyword string in the current state.</li> </ul> <p>The OPTIONS field also contains the following option:</p> <p style="padding-left: 40px;">TPA\$B_MCOUNT, TPA64\$B_MCOUNT — This byte contains the minimum number of characters allowed for the abbreviation of a keyword. If its value is zero, abbreviations are not allowed. Preventing ambiguity is the responsibility of the state table designer. If the ABBRFM or ABBREV flag is set, LIB\$T[ABLE_]PARSE ignores MCOUNT. MCOUNT is the high byte of the OPTIONS field.</p> |
| TPA64\$Q_STRINGDESC                | <p>For a 64-bit argument block, the three quadwords starting with TPA64\$Q_STRINGDESC form an embedded 64-bit descriptor for the input string.<sup>2</sup> On entry, LIB\$T[ABLE_]PARSE writes the fields of TPA64\$Q_STRINGDESC as follows:</p> <p style="padding-left: 40px;">DSC64\$B_CLASS = DSC64\$K_CLASS_S<br/>DSC64\$B_DTYPE = DSC64\$K_DTYPE_T<br/>DSC64\$L_MBMO = -1<br/>DSC64\$W_MBO = +1</p>   |

<sup>1</sup>LIB\$T[ABLE\_]PARSE defines bit masks TPA\$M\_BLANKS, TPA\$M\_ABBRFM, TPA\$M\_ABBREV, and TPA\$M\_AMBIG for use by languages such as MACRO. These bit masks correspond to the location of the \$V\_ fields in the OPTIONS field.

<sup>2</sup>See the *OpenVMS Calling Standard* manual for information about string descriptor fields.

(continued on next page)

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

Table LIB-10 (Cont.) LIB\$T[ABLE\_]PARSE Argument Block Fields

| Symbol   | Description  |
|--|--|
| TPA\$L_STRINGCNT<br>TPA64\$Q_STRINGCNT                       | <p>Contains the number of characters remaining in the input string.</p> <p>For a 32-bit argument block, TPA\$L_STRINGCNT and TPA\$L_STRINGPTR form an embedded 32-bit descriptor for the input string.<sup>2</sup></p> <p>For both 32-bit and 64-bit argument blocks:</p> <ul style="list-style-type: none"> <li>You must initialize the STRINGCNT and STRINGPTR fields to describe the input string. Use LIB\$ANALYZE_SDESC or LIB\$ANALYZE_SDESC_64 to read the string length and address from the string's descriptor and write them in STRINGCNT and STRINGPTR, respectively.</li> <li>Before LIB\$T[ABLE_]PARSE calls an action routine, it modifies STRINGCNT and STRINGPTR to describe the remainder of the input string.</li> <li>When LIB\$T[ABLE_]PARSE returns, STRINGCNT and STRINGPTR describe the portion of the input string that LIB\$T[ABLE_]PARSE did not process. This occurs whether LIB\$T[ABLE_]PARSE returns success or failure.</li> </ul> |
| TPA\$L_STRINGPTR<br>TPA64\$Q_STRINGPTR<br>TPA64\$Q_TOKENDESC | <p>Contains the address of the remainder of the string being parsed.</p> <p>For a 64-bit argument block, the three quadwords starting with TPA64\$Q_TOKENDESC form an embedded 64-bit descriptor for the current token.<sup>2</sup> On entry, LIB\$T[ABLE_]PARSE writes the fields of TPA64\$Q_TOKENDESC as follows:</p> <pre style="margin-left: 40px;"> DSC64\$B_CLASS = DSC64\$K_CLASS_S DSC64\$B_DTYPE = DSC64\$K_DTYPE_T DSC64\$L_MBMO = -1 DSC64\$W_MBO = +1 </pre>  |
| TPA\$L_TOKENCNT<br>TPA64\$Q_TOKENCNT                         | <p>Contains the number of characters in the current token.</p> <p>For a 32-bit argument block, TPA\$L_TOKENCNT and TPA\$L_TOKENPTR form an embedded 32-bit descriptor for the input token.<sup>2</sup></p> <p>For both 32-bit and 64-bit argument blocks, LIB\$T[ABLE_]PARSE updates TOKENCNT and TOKENPTR, to reflect the current token.</p>  |

<sup>2</sup>See the *OpenVMS Calling Standard* manual for information about string descriptor fields.

(continued on next page)

**Table LIB-10 (Cont.) LIB\$T[ABLE\_]PARSE Argument Block Fields**

| Symbol   | Description   |
|--|---|
| TPA\$L_TOKENPTR<br>TPA64\$Q_TOKENPTR                       | Contains the address of the current token.  |
| TPA\$B_CHAR <sup>3</sup><br>TPA64\$B_CHAR <sup>3</sup>     | Contains the character matched by one of the single-character symbol types: 'x', TPA\$_ANY, TPA\$_ALPHA, or TPA\$_DIGIT.  |
| TPA\$L_NUMBER <sup>3</sup><br>TPA64\$Q_NUMBER <sup>3</sup> | Contains the binary representation of a numeric token that matches TPA\$_OCTAL, TPA\$_DECIMAL, TPA\$_HEX, TPA\$_UIC, or TPA\$_IDENT. For a 64-bit argument block, it can also contain the binary representation of a numeric token that matches TPA\$_DECIMAL_64, TPA\$_OCTAL_64, or TPA\$_HEX_64.  |
| ‡TPA\$Q_NUMBER <sup>3</sup>                                | For a 32-bit argument block on an Alpha system, contains the binary representation of a numeric token that matches TPA\$_DECIMAL_64, TPA\$_OCTAL_64, or TPA\$_HEX_64. LIB\$T[ABLE_]PARSE converts the numeric token in the appropriate radix before storing it in the TPA\$Q_NUMBER field.<br><br>In the 32-bit argument block, TPA\$Q_NUMBER overlays TPA\$L_NUMBER and the longword in which TPA\$B_CHAR resides. |
| TPA\$L_PARAM<br>TPA64\$Q_PARAM                             | Contains the optional 32-bit argument supplied by the state transition in its <b>argument</b> argument. For a 64-bit argument block, LIB\$T[ABLE_]PARSE sign-extends the argument value before storing it in TPA64\$Q_PARAM.  |

---

<sup>3</sup>LIB\$T[ABLE\_]PARSE modifies TPA\$Q\_NUMBER prior to calling an action routine from a transition whose symbol type is listed in the TPA\$Q\_NUMBER Description column. It does not modify this field while executing a transition that specifies any other symbol type.

‡Alpha specific.

---

## 2. Coding and Using a Simple State Table

LIB\$T[ABLE\_]PARSE can be used to parse programming languages, command languages, or any other grammar for which a deterministic parser is the best choice.

Coding a program using LIB\$T[ABLE\_]PARSE involves three steps. Each step is defined in detail in a subsequent section.

1. Setting up state tables to implement your language's grammar.
2. Defining the argument block and other common variables.
3. Coding the main program, including the call to LIB\$T[ABLE\_]PARSE.

This section provides examples that demonstrate the use of LIB\$T[ABLE\_]PARSE to perform these three steps. The examples parse the command language of a simple report management utility. This hypothetical utility allows a user to perform the following activities:

- Obtain a list of available reports (SHOW command).

# LIB\$ Routines

## LIB\$TPARSE/LIB\$TABLE\_PARSE

- Read reports on the terminal (READ command).
- Print reports (PRINT command).
- Store new reports (FILE command).

The examples use the BASIC programming language for everything except the state and keyword tables, which are coded in BLISS.

This simple state table program does not use any action routines or other arguments. See the Using Advanced LIB\$T[ABLE\_]PARSE Features section for information about how to use these features of LIB\$T[ABLE\_]PARSE.

### 2.1 Setting Up a State Table

A state table associates the parser's alphabet with a set of possible transitions.

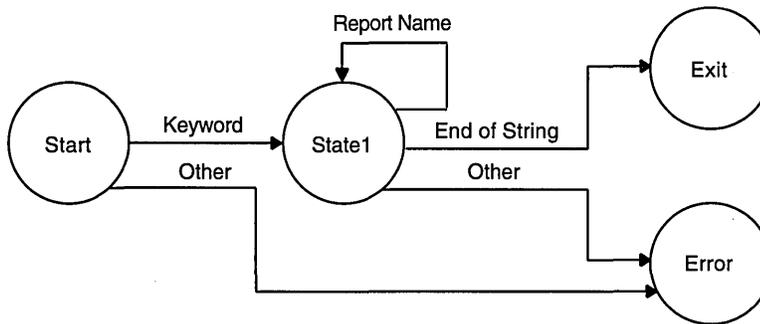
It is often helpful to create a graphical representation of a state table before attempting to code it. The following section illustrates two possible approaches.

#### 2.1.1 Diagramming the Transitions

One way to set up these tables is to start from a transition diagram of the language you want to parse. (If you do not know how to construct a transition diagram, you might find it helpful to read an introductory text about compiler design and construction before you start.) Each circle represents a state in the state table. Each arrow, labeled with an input option, represents a transition out of one state to another state or within the same state.

Figure LIB-22 shows a transition diagram for the hypothetical utility described in this section.

Figure LIB-22 Transition Diagram for a Hypothetical Utility



ZK-1933-GE

Another technique for developing a state table starts with a tabular diagram in which the first column is the starting state, the second column identifies the input token, or keyword, and the third gives the resultant state.

Figure LIB-23 is a tabular diagram of the same hypothetical utility that appears in Figure LIB-22.

**Figure LIB-23 Tabular Diagram of a Hypothetical Utility**

| Starting State | Input         | Resulting State |
|----------------|---------------|-----------------|
| Start          | PRINT         | State1          |
|                | READ          | State1          |
|                | FILE          | State1          |
|                | SHOW          | State1          |
|                | Other         | Error           |
| State1         | Report Name   | State1          |
|                | End of String | Exit            |
|                | Other         | Error           |

ZK-1980-GE

In this case, each unique entry in the Starting State or Resulting State column represents a state in the state table. Each entry in the Input column represents a possible transition out of the state in the Starting State column to a state in the Resulting State column.

### 2.1.2 Coding a State Table

For both MACRO and BLISS, you begin the state table with an \$INIT\_STATE macro. If you use MACRO to define your state table, then:

- Use the \$STATE macro to define each state.
- Follow each \$STATE macro with one instance of the \$TRAN macro for each transition from this state to another state or within the same state.

If you use BLISS to define the state table, then:

- Use the \$STATE macro to define each state and its associated transitions.

---

**Note**

---

The order in which you define the states is important. If you do not specify a target state for a transition, LIB\$TABLE\_PARSE transfers control to the state immediately following the current state in the state table.

---

The following MACRO and BLISS examples code the state table for the hypothetical utility diagrammed in Figure LIB-22 and Figure LIB-23. Note that neither of these state tables includes the error state. This is because LIB\$TABLE\_PARSE automatically generates an error if the input token does not match a transition in the current state. If you want to provide a transition to your own error state, code the last transition in the state with the TPA\$\_LAMBDA symbol type and specify a transition to your error state. The TPA\$\_LAMBDA symbol type matches any input token.

The state table, coded using MACRO, for this simple language looks like this:

```

        .TITLE simplelang
        .ident 'v1'

;+
; Define the LIB$TABLE_PARSE control symbols
;-
        $TPADEF
        $INIT_STATE SIMPLE_LANGUAGE_TABLE, SIMPLE_KEYWORD_TABLE

```

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

```

$STATE START
$TRAN 'PRINT', STATE1
$TRAN 'READ', STATE1
$TRAN 'FILE', STATE1
$TRAN 'SHOW', STATE1

$STATE STATE1
$TRAN TPA$ STRING, STATE1
$TRAN TPA$ _EOS, TPA$ _EXIT

$END_STATE

.END

```

Using the BLISS macros yields the following state table definition:

```

MODULE simple_statetable =
BEGIN
    !+
    ! These libraries contain the macros and other definitions
    ! needed to generate the state tables.
    !-
    LIBRARY 'SYS$LIBRARY:STARLET';
    LIBRARY 'SYS$LIBRARY:TPAMAC';
    !+
    ! UFD_STATE is the name you are giving the state table.
    ! UFD_KEY names the keyword table.
    ! Be sure to use the same name in the call to LIB$T[ABLE_]PARSE.
    !-
    $INIT_STATE      (UFD_STATE, UFD_KEY);
    !+
    ! Read the command name (to the first blank in the command).
    ! Each string is a keyword; you are limited to 220 keywords
    ! per state table.
    !-
    $STATE (START,
            ('CREATE',STATE1), !Be careful of your punctuation here.
            ('FILE',STATE1),  ! Each transition is surrounded by
            ('PRINT',STATE1), ! parentheses; each entry except the
            ('READ',STATE1)   ! last is followed by a comma.
            );
    $STATE (STATE1,
            (TPA$ STRING, STATE1), ! If there is more than one report name
            (TPA$ _EOS, TPA$ _EXIT) ! specified, go back and process it.
            );
    ! exit when done.

END
ELUDOM                                ! End of module CREATE_TABLE

Assemble or compile this module as you would any other program module.

```

## 2.2 Defining the Argument Block

After you have set up the state tables, you need to declare the LIB\$T[ABLE\_]PARSE argument block in such a way that both your program and LIB\$T[ABLE\_]PARSE can use it. This means the data must be defined in an area common to the calling program and the program module containing the state table definitions.

## LIB\$ Routines LIB\$TPARSE/LIB\$TABLE\_PARSE

In most programming languages you will use a combination of EXTERNAL statements and common data definitions to create and access a separate data PSECT. If you do not know what mechanisms the language you are using provides, consult the documentation for that language.

The following example shows the LIB\$T[ABLE\_]PARSE argument block defined for use in a BASIC program.

```

!LIB$T[ABLE_]PARSE requires that TPA$K_COUNT0 be eight.
DECLARE INTEGER CONSTANT TPA$K_COUNT0 = 8,      &
                    BTPA$L_COUNT = 0,          &
                    BTPA$L_OPTIONS=1,         &
                    BTPA$L_STRINGCNT=2,       &
                    BTPA$L_STRINGPTR=3,       &
                    BTPA$L_TOKENCNT=4,       &
                    BTPA$L_TOKENPTR=5,       &
                    BTPA$B_CHAR=6,           &
                    BTPA$L_NUMBER=7,        &
                    BTPA$L_PARAM=8
!+
! The LIB$T[ABLE_]PARSE argument block.
!-

MAP (TPARSE_BLOCK) LONG TPARSE_ARRAY (TPA$K_COUNT0)
!+
! Redefining the map allows you to use the standard
! LIB$T[ABLE_]PARSE symbolic names. TPA$L_STRINGCNT,
! for example, references the same storage location
! as TPARSE_ARRAY(2) and TPARSE_ARRAY(BTPA$L_STRINGCNT).
!-
MAP (TPARSE_BLOCK) LONG
                    TPA$L_COUNT ,             &
                    TPA$L_OPTIONS,           &
                    TPA$L_STRINGCNT,         &
                    TPA$L_STRINGPTR,         &
                    TPA$L_TOKENCNT,         &
                    TPA$L_TOKENPTR,         &
                    TPA$B_CHAR,             &
                    TPA$L_NUMBER,           &
                    TPA$L_PARAM

```

Before your program can call LIB\$T[ABLE\_]PARSE, it must place the necessary information in the argument block.

The example utility does not need to set any flags because it uses the LIB\$T[ABLE\_]PARSE defaults for options such as blanks processing and abbreviations. However, it must put the address and length of the string to be parsed into the TPA\$L\_STRINGCNT and TPA\$L\_STRINGPTR fields.

The address and the length of the string to be parsed are available in the descriptor of the input string (called COMMAND\_LINE in the following program). However, BASIC, like most high-level languages, does not allow you to look at the descriptors of your strings. Instead, you can use LIB\$ANALYZE\_SDESC or LIB\$ANALYZE\_SDESC\_64 to read the length and address from the string descriptor and place them in the argument block.

# LIB\$ Routines

## LIB\$PARSE/LIB\$TABLE\_PARSE

### 2.3 Coding the Call to LIB\$[ABLE\_]PARSE

Note that this program uses the BLISS state table described in the Coding a State Table section.

```
5 %TITLE "Program to demonstrate using LIB$[ABLE_]PARSE from a high-level language
```

```
OPTION TYPE=EXPLICIT

!+
! COMMAND_LINE is the string to receive the input
!   command from the terminal.
! ERROR_MSG_TEXT is the system error message
!   returned from LIB$SYS_GETMSG
!   (used in the error handling routine)
!-
DECLARE STRING COMMAND_LINE, ERROR_MSG_TEXT

!+
! RET_STATUS receives the status from the system calls.
! SAVE_STATUS is used when an error occurs
!   and the error handling routine calls
!   LIB$SYS_GETMSG to obtain the error text.
!-
DECLARE LONG RET_STATUS, SAVE_STATUS

!+
! UFD_STATE is the address of the state table.
! UFD_KEY is the address of the key table.
! Both addresses are set up by the macros in module
!   SIMPLE_STATETABLE32.
!-
EXTERNAL LONG UFD_STATE, UFD_KEY

!+
! To allow us to compare returned statuses more easily.
!-
EXTERNAL INTEGER CONSTANT SS$_NORMAL,    &
                        LIB$ SYNTAXERR,    &
                        LIB$ _INVTYPE

!+
! This program calls the following Run-Time Library
!   routines:
!
! LIB$[ABLE_]PARSE to parse the input string
!
! LIB$ANALYZE SDESC to get the length and starting
!   address of the command string and place them
!   in the LIB$[ABLE_]PARSE argument block.
!
! LIB$SYS_GETMSG to find the facility, severity, and text
!   of any system errors that occur
!   during program execution.
!-
EXTERNAL LONG FUNCTION LIB$TABLE_PARSE,    &
                        LIB$ANALYZE SDESC,    &
                        LIB$SYS_GETMSG
```

**LIB\$ Routines**  
**LIB\$TPARSE/LIB\$TABLE\_PARSE**

```

20      !+
      ! This file defines the argument block that is passed
      !   to LIB$T[ABLE_]PARSE. It also defines subscripts that
      !   make it easier to access the array.
      !
      ! Keeping the argument block definitions in a separate
      !   file makes them easier to modify and lets other
      !   programs use the same definitions.
      !-

      %INCLUDE "SIMPLE_TPARSE_BLOCK"

50      ON ERROR GOTO ERROR_HANDLER

60      !+
      ! LIB$T[ABLE_]PARSE requires that TPA$L_COUNT, the
      !   first field in the argument block, have a value
      !   of TPA$K_COUNT0, whose value is 8.
      !-

      TPA$L_COUNT = TPA$K_COUNT0

75      !+
      ! Prompt at the terminal for the user's action.
      ! A real utility should provide a friendlier,
      ! clearer interface.
      !-

      GET_INPUT:      PRINT "Your options are: ", " READ report "
                     PRINT , " FILE report "
                     PRINT , " PRINT report "
                     PRINT , " CREATE report "
                     PRINT
                     INPUT "What would you like to do"; COMMAND_LINE

      !+
      ! Get the length and starting address of the command line
      ! and place them in the LIB$T[ABLE_]PARSE argument block. Note
      ! that LIB$ANALYZE_SDESC stores the length as a word.
      !-

      RET_STATUS = LIB$ANALYZE_SDESC (COMMAND_LINE BY DESC, &
                                     TPARSE_ARRAY (BTPA$L_STRINGCNT) BY REF, &
                                     TPARSE_ARRAY (BTPA$L_STRINGPTR) BY REF)

      IF RET_STATUS <> SS$NORMAL THEN
          GOTO ERROR_HANDLER
      END IF

100     !+
      ! Call LIB$T[ABLE_]PARSE to process the input string.
      !
      ! Note that LIB$T[ABLE_]PARSE expects to receive its arguments
      ! by reference, while BASIC's default for arrays and
      ! strings is by descriptor. Therefore the BY REF
      ! clauses are required. Without them, LIB$T[ABLE_]PARSE
      ! cannot find the input string
      ! and the parse will always fail.
      !-

      RET_STATUS = LIB$TABLE_PARSE (TPARSE_ARRAY () BY REF, &
                                   UFD_STATE BY REF,
                                   UFD_KEY BY REF )

      !+
      ! This simple program provides no information except that
      ! a valid command was entered. The next section discusses
      ! techniques for gathering more information.
      !-

```

## LIB\$ Routines

### LIB\$PARSE/LIB\$TABLE\_PARSE

```
IF RET_STATUS = SS$ NORMAL
!+
! For now, exit on success.
!-
    THEN PRINT "Parse successful"
        GOTO 9999
!+
! If the parse failed, give the user a chance to try again.
!-
    ELSE IF RET_STATUS = LIB$ SYNTAXERR THEN
        PRINT "You did not enter a valid command."
        PRINT "Please try again."
        GOTO GET_INPUT
!+
! If a more serious error occurred, inform the user
! and exit.
!-
    ELSE
        Goto ERROR_HANDLER
    END IF
END IF
500 ERROR_HANDLER: SAVE_STATUS = RET_STATUS
RET STATUS = LIB$SYS GETMSG (SAVE_STATUS,,ERROR_MSG_TEXT)
PRINT "Something went wrong."
PRINT ERL, ERROR_MSG_TEXT
RESUME 9999
9999 END
```

Compile this program as you would any other BASIC program.

When both the state tables and the main program have been compiled, link them together to form a single executable image, as follows:

```
$ LINK SIMPLANG,SIMPLANG_STATETABLE
```

### 3. Using Advanced LIB\$T[ABLE\_]PARSE Features

The simple LIB\$T[ABLE\_]PARSE call in the previous program tells you that the command the user entered was valid, but nothing else—not even which command was entered. Most of the time your program will need more information than this.

The following sections describe some of the more complicated techniques you can use to process input strings or to gather extra information for your program. These include the use of:

- Action routines
- Blanks in the input string
- Special characters in the input string
- Abbreviated keywords
- Subexpressions
- LIB\$T[ABLE\_]PARSE in a modular fashion

### 3.1 Using Action Routines

After LIB\$T[ABLE\_]PARSE finds a match between a transition and the leading portion of the input string, it determines if the transition that made the match specified an action routine. If it did, LIB\$T[ABLE\_]PARSE stores the value of the transition's **argument** longword, if any, in the argument block PARAM field and calls the action routine.

- If the action routine returns success, LIB\$T[ABLE\_]PARSE processes the **mask** or **msk-adr** arguments, if any, and continues to execute the transition as it would if there was no action routine.
- If the action routine returns failure, LIB\$T[ABLE\_]PARSE does not execute the transition and continues attempting to match successive transitions.

#### 3.1.1 Passing Data to an Action Routine

An action routine has only one argument, the argument block. You can pass additional data to the action routine using:

- The transition's optional **argument** argument
- Fields you add to the end of the argument block

LIB\$TABLE\_PARSE and LIB\$TPARSE use different linkages for passing the argument block to the action routine:

- LIB\$TABLE\_PARSE uses the standard calling mechanism and passes the argument block, by reference, as the only argument to the action routine.

So, for OpenVMS systems, action routines are written as:

```
ROUTINE TEST( TPARSE_ARGUMENT_BLOCK : REF BLOCK[ , BYTE ] ) =
BEGIN
TPARSE_ARGUMENT_BLOCK[ TPA$V_ABBREV ] = 1
END;
```



- LIB\$TPARSE uses a nonstandard linkage that establishes the address of the argument block as the routine's actual argument pointer. Thus an action routine can reference fields in the argument block by their symbolic offsets relative to the AP (argument pointer) register.

For example:

```
ROUTINE TEST =
BEGIN
BUILTIN
    AP;
BIND
    TPARSE_ARGUMENT_BLOCK = AP : REF BLOCK[ , BYTE ];
TPARSE_ARGUMENT_BLOCK[ TPA$V_ABBREV ] = 1
END;◆
```

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

#### 3.1.2 Action Routine Return Values

The action routine returns a value to LIB\$T[ABLE\_]PARSE in R0 that controls execution of the current state transition. If the action routine returns success (low bit set in R0) then LIB\$T[ABLE\_]PARSE proceeds with the execution of the state transition. If the action routine returns failure (low bit clear in R0), LIB\$T[ABLE\_]PARSE rejects the transition that was being processed and acts as if the symbol type of that transition had not matched. It proceeds to evaluate other transitions in that state for eligibility.

---

#### Note

---

Prior to calling an action routine, LIB\$T[ABLE\_]PARSE sets the low bit of R0 to make it easier for the action routine to return success.

---

If an action routine returns a nonzero failure status to LIB\$T[ABLE\_]PARSE and no subsequent transitions in that state match, LIB\$T[ABLE\_]PARSE will return the status of the action routine, rather than the status LIB\$\_SYNTAXERR. In longword-valued functions in high-level languages, this value is returned in R0.

#### 3.1.3 Using an Action Routine to Reject a Transition

An action routine can intentionally return a failure status to force LIB\$T[ABLE\_]PARSE to reject a transition. This allows you to implement symbol types specific to particular applications. To recognize a specialized symbol type, code a state transition using a LIB\$T[ABLE\_]PARSE symbol type that describes a superset of the desired set of possible tokens. The associated action routine then performs the additional discrimination necessary and returns success or failure to LIB\$T[ABLE\_]PARSE, which then accordingly executes or fails to execute the transition.

A pure finite-state machine, for instance, has difficulty recognizing strings that are shorter than some maximum length or accepting numeric values confined to some particular range.

#### 3.2 Blanks in the Input String

The default mode of operation in LIB\$T[ABLE\_]PARSE is to treat blanks as separators. That is, they can appear between any two tokens in the string being parsed without being called for by transitions in the state table. Since blanks are significant in some situations, LIB\$T[ABLE\_]PARSE processes blanks if you have set the bit TPA\$V\_BLANKS in the options longword of the argument block. The following input string shows the difference in operation:

ABC DEF

LIB\$T[ABLE\_]PARSE recognizes the string by the following sequences of state transitions, depending on the state of the blanks control flag. The following examples illustrate processing with and without TPA\$V\_BLANKS set:

- TPA\$V\_BLANKS set:
 

```

$STATE
$TRAN TPA$_STRING

$STATE
$TRAN TPA$_BLANK

$STATE
$TRAN TPA$_STRING

```
- TPA\$V\_BLANKS clear:
 

```

$STATE
$TRAN TPA$_STRING

$STATE
$TRAN TPA$_STRING

```

Your action routines can set or clear TPA\$V\_BLANKS as LIB\$T[ABLE\_]PARSE enters or leaves sections of the state table in which blanks are significant. LIB\$T[ABLE\_]PARSE always checks the blanks control flag as it enters a state. If the flag is clear, it removes any space or tab characters present at the front of the input string before it proceeds to evaluate transitions. Note that when the TPA\$V\_BLANKS flag is clear, the TPA\$\_BLANK symbol type will never match. If TPA\$V\_BLANKS is set, you must explicitly process blanks.

### 3.3 Special Characters in the Input String

Not all members of the ASCII character set can be entered directly in the state table definitions. Examples include the single quotation mark and all control characters.

In MACRO state tables, such characters can be specified as the symbol type with any assembler expression that is equivalent to the ASCII code of the desired character, not including the single quotes. For example, you could code a transition to match a backspace character as follows:

```

BACKSPACE = 8
.
.
$TRAN BACKSPACE, ...

```

MACRO places extra restrictions on the use of a comma in arguments to macros; often they must be surrounded by one or more angle brackets. Using a symbolic name for the comma will avoid such difficulties.

To build a transition matching such a single character in a BLISS state table, you can use the %CHAR lexical function as follows:

```

LITERAL BACKSPACE = 8;
.
.
$STATE (label,
        (%CHAR (BACKSPACE), ... )
        );

```

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

#### 3.4 Abbreviating Keywords

The default mode of LIB\$T[ABLE\_]PARSE is exact match. All keywords in the input string must exactly match their spelling, length and case in the state table. However, many languages (command languages in particular) allow you to abbreviate keywords. For this reason, LIB\$T[ABLE\_]PARSE has three abbreviation facilities to permit the recognition of abbreviated keywords when the state table lists only the full spellings. All three are controlled by flags and options defined in the argument block OPTIONS field. Table LIB-11 describes these flags.

**Table LIB-11 Keyword Abbreviation Flags**

| Flag                             | Description  |
|----------------------------------|--|
| TPA\$B_MCOUNT<br>TPA64\$B_MCOUNT | By setting a value in the MCOUNT argument block field, the calling program or action routine specifies a minimum number of characters from the abbreviated keyword that must be present for a match to occur. For example, setting the byte to the value 4 would allow the keyword DEASSIGN to appear in an input string as DEAS, DEASS, DEASSI, DEASSIG, or DEASSIGN. LIB\$T[ABLE_]PARSE checks all the characters of the keyword string. Incorrect spellings beyond the minimum abbreviation are not permitted.  |
| TPA\$V_ABBRFM<br>TPA64\$V_ABBRFM | If you set the ABBRFM flag in the argument block OPTIONS field, LIB\$T[ABLE_]PARSE recognizes any leftmost substring of a keyword as a match for that keyword. LIB\$T[ABLE_]PARSE does not check for ambiguity; it matches the first keyword listed in the state table of which the input token is a subset. For proper recognition of ambiguous keywords, the keywords in each state must be arranged in alphabetical order by the ASCII collating sequence as follows:<br><br>Dollar sign (\$)<br>Numerics<br>Uppercase alphabets<br>Underscore (_)<br>Lowercase alphabets |

(continued on next page)

**Table LIB-11 (Cont.) Keyword Abbreviation Flags**

| Flag                             | Description  |
|----------------------------------|--|
| TPA\$V_ABBREV<br>TPA64\$V_ABBREV | <p>If you set the ABBREV flag in the argument block OPTIONS field, LIB\$T[ABLE_]PARSE recognizes any abbreviation of a keyword as long as it is unambiguous among the keywords in that state.</p> <p>If LIB\$T[ABLE_]PARSE finds that the front of the input string contains an ambiguous keyword string, it sets the AMBIG flag in the OPTIONS field and refuses to recognize any keyword transitions in that state. (It still accepts other symbol types.) The AMBIG flag can be checked by an action routine that is called when coming out of that state, or by the calling program if LIB\$T[ABLE_]PARSE returns with a syntax error status. LIB\$T[ABLE_]PARSE clears the flag when it enters the next state.</p> <p>If both the ABBRFM and ABBREV flags are set, ABBRFM takes precedence.</p> |

**Note**

Be careful when using a keyword abbreviation option. Permitting short abbreviations or ambiguity restricts the extensibility of a language. Adding a new keyword can make a formerly valid abbreviation ambiguous.

### 3.5 Using Subexpressions

LIB\$T[ABLE\_]PARSE subexpressions are analogous to subroutines within the state table. You can use subexpressions as you would use subroutines in any program:

- To avoid replication of complex expressions.
- For a limited form of pushdown parsing, in which the state table contains recursively nested subexpressions.
- For nondeterministic parsing, that is, parsing in which you need some number of states of look-ahead. To do this, place each path of look-ahead in a separate subexpression and call the subexpressions in the transitions of the state that needs the look-ahead. When a look-ahead path fails, the subexpression failure mechanism causes LIB\$T[ABLE\_]PARSE to back out and try another path.

A subexpression call is indicated with the MACRO expression **!label** or the BLISS expression **(label)** as the transition **type** argument. Transfer of control to a subexpression causes LIB\$T[ABLE\_]PARSE to call itself recursively, using the same argument block and keyword table as the original call, and using the specified state label as a starting state.

The following statement is an example of a \$TRAN macro that calls a subexpression:

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

```
$TRAN !Q_STRING,,,,Q_DESCRIPTOR
```

In this example, Q\_STRING is the label of another state, a subexpression, in the same state table.

When LIB\$T[ABLE\_]PARSE evaluates a transition that transfers control to a subexpression, it evaluates the subexpression's transitions and processes the remaining input string.

- If the subexpression succeeds, it returns success to LIB\$T[ABLE\_]PARSE by executing a transition to TPA\$\_EXIT. LIB\$T[ABLE\_]PARSE thus considers the calling transition to have made a match. It calls that transition's action routine, if any, and executes the transition.
- If the subexpression fails, LIB\$T[ABLE\_]PARSE considers the calling transition to have no match. It backs up the input string, leaving it as it was at the start of the subexpression, and continues processing by evaluating the remaining transitions in the calling state.

#### 3.5.1 Using Action Routines and Storing Data in a Subexpression

Be careful when designing subexpressions whose transitions provide action routines or use the **mask** and **msk-adr** arguments. As LIB\$T[ABLE\_]PARSE processes the state transitions of a subexpression, it calls the specified action routines and stores the **mask** and **msk-adr**. If the subexpression fails, LIB\$T[ABLE\_]PARSE backs up the input string and resumes processing in the calling state. However, any effect that an action routine has had on the caller's database cannot be undone.

If subexpressions are being used only as state table subroutines, there is usually no harm done, since when a subexpression fails in this mode, the parse generally fails. This is not true of pushdown or nondeterministic parsing. In applications where you expect subexpressions to fail, design action routines to store results in temporary storage. You can then make these results permanent at the main level, where the flow of control is deterministic.

#### 3.5.2 An Example: Parsing a Quoted String

The following example is an excerpt of a state table that parses a string quoted by an arbitrary character. The table interprets the first character that appears as a quote character. Many text editors and some programming languages contain this sort of construction.

LIB\$T[ABLE\_]PARSE processes a transition that invokes a subexpression as it would any other transition:

- If the subexpression returns success by executing a transition to TPA\$\_EXIT, LIB\$T[ABLE\_]PARSE considers the calling transition to have a match. It updates Q\_DESCRIPTOR to describe the substring parsed by the subexpression and executes the transition to the next state in the state table.
- If the subexpression returns failure by executing a transition to TPA\$\_FAIL, LIB\$T[ABLE\_]PARSE considers the calling transition to have no match. It restores the input string as it was when the subexpression was called and continues by evaluating the next transition in the state.

## LIB\$ Routines LIB\$PARSE/LIB\$TABLE\_PARSE

```

;+
; Main level state table. The first transition accepts and
; stores the quoting character.
;-
    $STATE    STRING
    $STRAN    TPA$ _ANY,,,,Q_CHAR
;+
; Call the subexpression to accept the quoted string and store
; the string descriptor. Note that the descriptor spans all
; the characters accepted by the subexpression.
;-
    $STATE
    $STRAN    !Q_STRING,,,,Q_DESCRIPTOR
    $STRAN    TPA$ _LAMBDA,TPA$ _FAIL
;+
; Accept the trailing quote character, left behind by the
; subexpression
;-
    $STATE
    $STRAN    TPA$ _ANY,NEXT
;+
; Subexpression to scan the quoted string. The second transition
; matches until it is rejected by the action routine. The subexpression
; should never encounter the end of string before the final quoting
; character.
;-
    $STATE    Q_STRING
    $STRAN    TPA$ EOS,TPA$ FAIL
    $STRAN    TPA$ _ANY,Q_STRING,TEST_Q
    $STRAN    TPA$ _LAMBDA,TPA$ _EXIT
;+
; The following MACRO subroutine compares the current character
; with the quoting character and returns failure if it matches.
;-
TEST_Q: .WORD    0                ; null entry mask
        CMPB    TPA$B_CHAR(AP),Q_CHAR ; check the character
        BNEQ    10$              ; note R0 is already 1
        CLRL    R0                ; match - reject transition
10$:    RET

```

### 3.5.3 An Example: Parsing a Complex Grammar

The following example is an excerpt from a state table that shows how to use subexpressions to parse a complex grammar. The state table accepts a number followed by a keyword qualifier. Depending on the keyword, the table interprets the number as decimal, octal, or hexadecimal. The state table accepts strings such as the following:

```

10/OCTAL
32768/DECIMAL
77AF/HEX

```

This sort of grammar is difficult to parse with a deterministic finite-state machine. Using a subexpression look-ahead of two states permits a simpler expression of the state tables.

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

```

;+
; Main state table entry. Accept a number of some type and store
; its value at the location NUMBER.
;-
    $STATE
    $TRAN    !OCT_NUM,NEXT,,,NUMBER
    $TRAN    !DEC_NUM,NEXT,,,NUMBER
    $TRAN    !HEX_NUM,NEXT,,,NUMBER
;+
; Subexpressions to accept an octal number followed by the OCTAL
; qualifier.
;-
    $STATE    OCT_NUM
    $TRAN    TPA$OCTAL
    $STATE
    $TRAN    '/'
    $STATE
    $TRAN    'OCTAL',TPA$EXIT
;+
; Subexpression to accept a decimal number followed by the DECIMAL
; qualifier.
;-
    $STATE    DEC_NUM
    $TRAN    TPA$DECIMAL
    $STATE
    $TRAN    '/'
    $STATE
    $TRAN    'DECIMAL',TPA$EXIT
;+
; Subexpression to accept a hex number followed by the HEX
; qualifier.
;-
    $STATE    HEX_NUM
    $TRAN    TPA$HEX
    $STATE
    $TRAN    '/'
    $STATE
    $TRAN    'HEX',TPA$EXIT

```

Note that the transitions that follow a match with a numeric token do not disturb the NUMBER field in the argument block. This allows the main level subexpression call to retrieve it when the subexpression returns.

### 3.6 LIB\$T[ABLE\_]PARSE and Modularity

To use LIB\$T[ABLE\_]PARSE in a modular and shareable fashion:

- Avoid using OWN storage. Instead, allocate the argument block on the stack or the heap.
- Do not use the **msk-adr** argument.
- Do not use the **argument** argument as an address. If additional context is needed, allocate it at the end of the argument block.
- Use action routines to control flags such as TPA\$V\_BLANKS. The MACRO example at the end of the LIB\$TPARSE/LIB\$TABLE\_PARSE section shows such an action routine, though the program itself is not modular.

## 4. Data Representation

This section describes the binary representation and allocation of a LIB\$T[ABLE\_]PARSE state table and a keyword table. While this information is not required to use LIB\$T[ABLE\_]PARSE, it may be useful in debugging your program.

### 4.1 State Table Representation

Each state consists of its transitions concatenated in memory. LIB\$T[ABLE\_]PARSE equates the state label to the address of the first byte of the first transition. A marker in the last transition identifies the end of the state. The LIB\$T[ABLE\_]PARSE table macros build the state table in the PSECT \_LIB\$STATE\$.

Each transition in a state consists of 2 to 23 bytes containing the arguments of the transition. The state table generation macros do not allocate storage for arguments not specified in the transition macro. This allows simple transitions to be represented efficiently. For example, the following transition, which simply accepts the character “?” and falls through to the next state, is represented in two bytes:

```
$TRAN '?'
```

In this section, pointers described as self-relative are signed displacements from the address following the end of the pointer (this is identical to branch displacements in the OpenVMS VAX instruction set).

Table LIB-12 describes the elements of a state transition in the order in which they appear, if present, in the transition. If a transition does not include a specific option, no bytes are assigned to the option within the transition.

**LIB\$ Routines**  
**LIB\$TPARSE/LIB\$TABLE\_PARSE**

**Table LIB-12 Binary Representation of a LIB\$T[ABLE\_]PARSE State Transition**

| Transition Element | No. of Bytes                             | Description  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
|--------------------|--|--|-------------|-----------------|-----|--------------------------------------|-----------|------------------------------|-------------------|-----|-----------------|-----|---------------|-----|----------------|-----|--------------------|-----|------------|-----|----------------|-----|-----------|-----|-------------|-----|-----------|-----|-------------|-----|-------------|-----|--------------|-----|--------------|-----|-------------|-----|---------------|-----|-------------|-----|-----------|-----|--------------|-----|-----------|-----|---------------|--------------------------|--|--|
| Symbol type        | 1  | The first byte of a transition contains the binary coding of the symbol type accepted by this transition. It is always present. Flag bit 0 in the flags byte controls the interpretation of the type byte. If the flag is clear, the type byte represents a single character (the 'x' construct). If the flag bit is set, the type byte is one of the other type codes (keyword, number, and so forth). The following table lists the symbol types accepted by LIB\$T[ABLE_]PARSE.   |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
|                    |  | <table border="1"> <thead> <tr> <th>Symbol Type</th> <th>Binary Encoding</th> </tr> </thead> <tbody> <tr> <td>'x'</td> <td>ASCII code of the character (8 bits)</td> </tr> <tr> <td>'keyword'</td> <td>The keyword index (0 to 219)</td> </tr> <tr> <td>‡TPA\$_DECIMAL_64</td> <td>228</td> </tr> <tr> <td>‡TPA\$_OCTAL_64</td> <td>229</td> </tr> <tr> <td>‡TPA\$_HEX_64</td> <td>230</td> </tr> <tr> <td>TPA\$_NODE_ACS</td> <td>231</td> </tr> <tr> <td>TPA\$_NODE_PRIMARY</td> <td>232</td> </tr> <tr> <td>TPA\$_NODE</td> <td>233</td> </tr> <tr> <td>TPA\$_FILESPEC</td> <td>234</td> </tr> <tr> <td>TPA\$_UIC</td> <td>235</td> </tr> <tr> <td>TPA\$_IDENT</td> <td>236</td> </tr> <tr> <td>TPA\$_ANY</td> <td>237</td> </tr> <tr> <td>TPA\$_ALPHA</td> <td>238</td> </tr> <tr> <td>TPA\$_DIGIT</td> <td>239</td> </tr> <tr> <td>TPA\$_STRING</td> <td>240</td> </tr> <tr> <td>TPA\$_SYMBOL</td> <td>241</td> </tr> <tr> <td>TPA\$_BLANK</td> <td>242</td> </tr> <tr> <td>TPA\$_DECIMAL</td> <td>243</td> </tr> <tr> <td>TPA\$_OCTAL</td> <td>244</td> </tr> <tr> <td>TPA\$_HEX</td> <td>245</td> </tr> <tr> <td>TPA\$_LAMBDA</td> <td>246</td> </tr> <tr> <td>TPA\$_EOS</td> <td>247</td> </tr> <tr> <td>TPA\$_SUBEXPR</td> <td>248 (subexpression call)</td> </tr> <tr> <td></td> <td>(Other codes are reserved for expansion)</td> </tr> </tbody> </table> | Symbol Type | Binary Encoding | 'x' | ASCII code of the character (8 bits) | 'keyword' | The keyword index (0 to 219) | ‡TPA\$_DECIMAL_64 | 228 | ‡TPA\$_OCTAL_64 | 229 | ‡TPA\$_HEX_64 | 230 | TPA\$_NODE_ACS | 231 | TPA\$_NODE_PRIMARY | 232 | TPA\$_NODE | 233 | TPA\$_FILESPEC | 234 | TPA\$_UIC | 235 | TPA\$_IDENT | 236 | TPA\$_ANY | 237 | TPA\$_ALPHA | 238 | TPA\$_DIGIT | 239 | TPA\$_STRING | 240 | TPA\$_SYMBOL | 241 | TPA\$_BLANK | 242 | TPA\$_DECIMAL | 243 | TPA\$_OCTAL | 244 | TPA\$_HEX | 245 | TPA\$_LAMBDA | 246 | TPA\$_EOS | 247 | TPA\$_SUBEXPR | 248 (subexpression call) |  | (Other codes are reserved for expansion) |
| Symbol Type        | Binary Encoding                          |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| 'x'                | ASCII code of the character (8 bits)     |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| 'keyword'          | The keyword index (0 to 219)             |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| ‡TPA\$_DECIMAL_64  | 228                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| ‡TPA\$_OCTAL_64    | 229                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| ‡TPA\$_HEX_64      | 230                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_NODE_ACS     | 231                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_NODE_PRIMARY | 232                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_NODE         | 233                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_FILESPEC     | 234                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_UIC          | 235                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_IDENT        | 236                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_ANY          | 237                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_ALPHA        | 238                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_DIGIT        | 239                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_STRING       | 240                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_SYMBOL       | 241                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_BLANK        | 242                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_DECIMAL      | 243                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_OCTAL        | 244                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_HEX          | 245                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_LAMBDA       | 246                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_EOS          | 247                                      |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
| TPA\$_SUBEXPR      | 248 (subexpression call)                 |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |
|                    | (Other codes are reserved for expansion) |  |             |                 |     |                                      |           |                              |                   |     |                 |     |               |     |                |     |                    |     |            |     |                |     |           |     |             |     |           |     |             |     |             |     |              |     |              |     |             |     |               |     |             |     |           |     |              |     |           |     |               |                          |  |  |

‡Alpha specific

(continued on next page)

LIB\$ Routines  
LIB\$TPARSE/LIB\$TABLE\_PARSE

Table LIB-12 (Cont.) Binary Representation of a LIB\$T[ABLE\_]PARSE State Transition

| Transition Element     | No. of Bytes                                     | Description  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
|------------------------|--|--|-----|-------------|---|---|---|--|---|--|---|--|---|---|---|---|---|--|---|--|
|                        |  | Use of the TPA\$_FILESPEC, TPA\$_NODE, TPA\$_NODE_PRIMARY, or TPA\$_NODE_ACS symbol type results in calls to the OpenVMS system service \$FILESCAN. Use of the symbol type TPA\$_IDENT results in calls to the OpenVMS \$ASCTOID system service. If your application of LIB\$T[ABLE_]PARSE runs in an environment other than OpenVMS user mode, you must carefully evaluate whether use of these services is consistent with your environment.   |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| First flags byte       | 1  | This byte contains the following bits, which specify the options of the transition. It is always present.  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
|                        |  | <table border="1" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Bit</th> <th style="text-align: left;">Description</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Set if the type byte is not a single character.</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Set if the second flags byte is present.</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Set if this is the last transition in the state.</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Set if a subexpression pointer is present.</td> </tr> <tr> <td style="text-align: center;">4</td> <td>Set if an explicit target state is present.</td> </tr> <tr> <td style="text-align: center;">5</td> <td>Set if the <b>mask</b> longword is present.</td> </tr> <tr> <td style="text-align: center;">6</td> <td>Set if the <b>msk-adr</b> longword is present.</td> </tr> <tr> <td style="text-align: center;">7</td> <td>Set if an action routine address is present.</td> </tr> </tbody> </table> | Bit | Description | 0 | Set if the type byte is not a single character. | 1 | Set if the second flags byte is present. | 2 | Set if this is the last transition in the state. | 3 | Set if a subexpression pointer is present. | 4 | Set if an explicit target state is present. | 5 | Set if the <b>mask</b> longword is present. | 6 | Set if the <b>msk-adr</b> longword is present. | 7 | Set if an action routine address is present. |
| Bit                    | Description                                      |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 0                      | Set if the type byte is not a single character.  |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 1                      | Set if the second flags byte is present.         |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 2                      | Set if this is the last transition in the state. |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 3                      | Set if a subexpression pointer is present.       |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 4                      | Set if an explicit target state is present.      |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 5                      | Set if the <b>mask</b> longword is present.      |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 6                      | Set if the <b>msk-adr</b> longword is present.   |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 7                      | Set if an action routine address is present.     |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| Second flags byte      | 1  | This byte is present if any of its flag bits is set. It contains an additional flag describing the transition. It is used as follows:  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
|                        |  | <table border="1" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Bit</th> <th style="text-align: left;">Description</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Set if the action routine argument is present.</td> </tr> </tbody> </table>  | Bit | Description | 0 | Set if the action routine argument is present.  |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| Bit                    | Description                                      |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| 0                      | Set if the action routine argument is present.   |  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| Subexpression pointer  | 2  | This word is present in transitions that are subexpression calls. It is a 16-bit signed self-relative pointer to the starting state of the subexpression.  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| Argument longword      | 4  | This longword field contains the 32-bit action routine argument, when specified.   |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| Action routine address | 4  | This longword contains a self-relative pointer to the action routine, when specified.  |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |
| Bit mask               | 4  | This longword contains the <b>mask</b> argument, when specified.   |     |             |   |   |   |  |   |  |   |  |   |   |   |   |   |  |   |  |

(continued on next page)

## LIB\$ Routines

### LIB\$TPARSE/LIB\$TABLE\_PARSE

Table LIB-12 (Cont.) Binary Representation of a LIB\$T[ABLE\_]PARSE State Transition

| Transition Element | No. of Bytes | Description   |
|--------------------|--------------|---|
| Mask address       | 4            | This longword, when specified, contains a self-relative pointer through which the <b>mask</b> , or data that depends on the symbol type, is to be stored. Because the pointer is self-relative, when it points to an absolute location, the state table is not PIC (position-independent code). |
| Transition target  | 2            | This word, when specified, contains the address of the target state of the transition. The address is stored as a 16-bit signed self-relative pointer. The final state TPA\$_EXIT is coded as a word whose value is -1; the failure state TPA\$_FAIL is coded as a word whose value is -2.      |

#### 4.2 Keyword Table Representation

The keyword table is a vector of 16-bit signed pointers that address locations in the keyword string area, relative to the start of the keyword vector. It is the structure to which the \$INIT\_STATE macro equates its second argument.

The LIB\$T[ABLE\_]PARSE macros assign an index number to each keyword. The index number is stored in the symbol type byte in the transition; it locates the associated keyword vector entry. The keyword strings are stored in the order encountered in the state table. Each keyword string is terminated by a byte containing the value -1. Between the keywords of adjacent states is an additional -1 byte to stop the ambiguous keyword scan.

To ensure that the keyword vector is adjacent to the keyword string area, the keyword vector is located in PSECT \_LIB\$KEY0\$ and the keyword strings and stored in PSECT \_LIB\$KEY1\$.

Your program should not use any of the three PSECTs used by LIB\$T[ABLE\_]PARSE (\_LIB\$STATE\$, \_LIB\$KEY0\$, and \_LIB\$KEY1\$). The PSECTs \_LIB\$KEY0\$ and \_LIB\$KEY1\$ refer to each other using 16-bit displacements, so user PSECTs inserted between them can cause truncation errors from the linker.

#### Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.<br>LIB\$T[ABLE_]PARSE has executed a transition to TPA\$_EXIT at main level, not within a subexpression.   |
| LIB\$_SYNTAXERR | Parse completed with syntax error.<br>LIB\$T[ABLE_]PARSE has encountered a state at main level in which none of the transitions match the input string, or in which a transition to TPA\$_FAIL was executed. |

## LIB\$ Routines LIB\$TPARSE/LIB\$TABLE\_PARSE

|               |  |
|---------------|--|
| LIB\$_INVTYPE | State table error. LIB\$T[ABLE_]PARSE has encountered an invalid entry in the state table.   |
| Other         | If an action routine returns a failure status other than zero, and the parse consequently fails, LIB\$T[ABLE_]PARSE returns the status returned by the action routine. |

### Example 1a

The following DEC C program accepts and parses the command line of a CREATE/DIRECTORY command using LIB\$TABLE\_PARSE. It uses the state table defined in Example 1b.

```
/*
** This DEC C program accepts and parses the command line of a CREATE/DIRECTORY
** command. This program uses the LIB$GET_FOREIGN call to acquire the command
** line from the CLI and parse it with LIB$TABLE_PARSE, leaving the necessary
** information in its global data base. The command line is of
** the following format:
**
**      CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
**              /OWNER UIC=[2437,25]
**              /ENTRIES=100
**              /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
**
** The three qualifiers are optional. Alternatively, the command
** may take the form:
**
**      CREATE/DIR DEVICE:[202,31]
**
** using any of the optional qualifiers.
**
** The source for this program can be found in:
**
**      SYS$EXAMPLES:LIB$TABLE_PARSE_DEMO.COM
**
*/

/*
** Specify the required header files
*/

# include <tpadef.h>
# include <descrip.h>
# include <starlet.h>
# include <lib$routines.h>

/*
** Specify macro definitions
*/

# define max_name_count 8
# define max_token_size 9
# define uic_string_size 6
# define command_buffer_size 256

/*
** Specify persistent data that's local to this module
*/
```

# LIB\$ Routines

## LIB\$PARSE/LIB\$TABLE\_PARSE

```

static
union
    uic union {
        __int32 bits;
        struct {
            char first;
            char second;
        } bytes;
        struct {
            __int16 first;
            __int16 second;
        } words;
    }
    file_owner;                                /* Actual file owner UIC */

static
int
    name_count;                                /* Number of directory names */

static
char
    uic_string[ uic_string_size + 1 ];        /* Buffer for string */

static
struct
    dsc$descriptor_s
        name_vector[ max_name_count ];        /* Vector of descriptors */

/*
** Specify persistent data that's global to this module.
** This data is referenced externally by the state table definitions.
*/

union
    uic union
        uic_group,                            /* Tempt for UIC group */
        uic_member;                            /* Tempt for UIC member */

int
    parser_flags,                              /* Keyword flags */
    entry_count,                              /* Space to preallocate */
    file_protect;                             /* Directory file protection */

struct
    dsc$descriptor_s
        device_string =                        /* Device string descriptor */
        { 0, DSC$K_DTYPE_T, DSC$K_CLASS_S, (char *) 0 };

/*
** Specify the user action routines.
**
** Please note that if it were LIB$TPARSE being called, the user action
** routines would have to be coded as follows:
**
**     int user_action_routine( __int32 psuedo_ap )
**     {
**         struct tpadef
**             *tparse_block = (tpadef *) (&psuedo_ap - 1);
**         printf( "Parameter value: %d\n",
**             tparse_block->tpa$1_param
**             );
**     }
**
*/

/*
** Shut off explicit blank processing after passing the command name.
**
*/

```

**LIB\$ Routines**  
**LIB\$PARSE/LIB\$TABLE\_PARSE**

```

int blanks_off( struct tparse_block ) {
    tparse_block->tpa$w_blanks = 0;
    return( 1 );
}

/*
** Check the UIC for legal value range.
*/

int check_uic( struct tparse_block ) {
    if ( (uic_group.words.second != 0) ||
        (uic_member.words.second != 0)
        )
        return( 0 );

    file_owner.words.first = uic_member.words.first;
    file_owner.words.second = uic_group.words.first;

    return( 1 );
}

/*
** Store a directory name component.
*/

int store_name( struct tparse_block ) {
    if ( (name_count >= max_name_count) ||
        (tparse_block->tpa$l_tokencnt > max_token_size)
        )
        return( 0 );

    name_vector[ name_count ].dsc$w_length = tparse_block->tpa$l_tokencnt;
    name_vector[ name_count ].dsc$b_dtype = DSC$K_DTYPE_T;
    name_vector[ name_count ].dsc$b_class = DSC$K_CLASS_S;
    name_vector[ name_count++ ].dsc$a_pointer = tparse_block->tpa$l_tokenptr;

    return( 1 );
}

/*
** Convert a UIC into its equivalent directory file name.
*/

int make_uic( struct tparse_block ) {
    $DESCRIPTOR( control_string, "IOBIOB" );
    $DESCRIPTOR( dirname, uic_string );

    if ( (uic_group.bytes.second != '\0') ||
        (uic_member.bytes.second != '\0')
        )
        return( 0 );

    sys$fao( &control_string,
            &dirname.dsc$w_length,
            &dirname,
            uic_group.bytes.first,
            uic_member.bytes.first
            );

    return( 1 );
}

/*
** The main program section starts here.
*/

main( ) {

```

## LIB\$ Routines

### LIB\$PARSE/LIB\$TABLE\_PARSE

```
/*
** This program creates a directory. It gets the command
** line from the CLI and parses it with LIB$TABLE_PARSE.
*/

extern
  char
    ufd_state,
    ufd_key;

char
  command_buffer[ command_buffer_size + 1 ];

int
  status;

$DESCRIPTOR( prompt, "Command> " );
$DESCRIPTOR( command_descriptor, command_buffer );

struct
  tparse_block = { TPA$K_COUNT0,          /* Longword count */
                  TPA$M_ABBREV          /* Allow abbreviation */
                  |
                  TPA$M_BLANKS          /* Process spaces explicitly */
                };

status = lib$get_foreign( &command_descriptor,
                        &prompt,
                        &command_descriptor.dsc$w_length
                        );

if ( (status & 1) == 0 )
  return( status );

/*
** Copy the input string descriptor into the control block
** and then call LIB$TABLE_PARSE. Note that impure storage is assumed
** to be zero.
*/

tparse_block.tpa$l_stringcnt = command_descriptor.dsc$w_length;
tparse_block.tpa$l_stringptr = command_descriptor.dsc$a_pointer;

return( status = lib$table_parse( &tparse_block, &ufd_state, &ufd_key ) );
}
```

### Example 1b

The following MACRO assembly language program module defines the state tables for the preceding sample program.

```
.TITLE      CREATE_DIR_TABLES - Create Directory File (tables)
.IDENT      "X-1"

;+
;
; This module defines the state tables for the preceding
; sample program, which accepts and parses the command line of the
; CREATE/DIRECTORY command. The command line has the following format:
;
;       CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
;               /OWNER UIC=[2437,25]
;               /ENTRIES=100
;               /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
;
; The three qualifiers are optional. Alternatively, the command
; may take the form
;
;       CREATE/DIR DEVICE:[202,31]
;
; using any of the optional qualifiers.
;
;-
;+
;
; Global data, control blocks, etc.
;
;-
        .PSECT  IMPURE,WRT,NOEXE
;+
; Define control block offsets
;-

$CLIDEF
$TPADEF

        .EXTRN BLANKS OFF, -           ; No explicit blank processing
              CHECK_UIC, -           ; Validate and assemble UIC
              STORE_NAME, -         ; Store next directory name
              MAKE_UIC              ; Make UIC into directory name

;+
; Define parser flag bits for flags longword
;-
UIC_FLAG      = 1           ; /UIC seen
ENTRIES_FLAG  = 2           ; /ENTRIES seen
PROT_FLAG     = 4           ; /PROTECTION seen

        .SBTTL      Parser State Table

;+
; Assign values for protection flags to be used when parsing protection
; string.
;-
```

# LIB\$ Routines

## LIB\$PARSE/LIB\$TABLE\_PARSE

```

SYSTEM_READ_FLAG = ^X0001
SYSTEM_WRITE_FLAG = ^X0002
SYSTEM_EXECUTE_FLAG = ^X0004
SYSTEM_DELETE_FLAG = ^X0008
OWNER_READ_FLAG = ^X0010
OWNER_WRITE_FLAG = ^X0020
OWNER_EXECUTE_FLAG = ^X0040
OWNER_DELETE_FLAG = ^X0080
GROUP_READ_FLAG = ^X0100
GROUP_WRITE_FLAG = ^X0200
GROUP_EXECUTE_FLAG = ^X0400
GROUP_DELETE_FLAG = ^X0800
WORLD_READ_FLAG = ^X1000
WORLD_WRITE_FLAG = ^X2000
WORLD_EXECUTE_FLAG = ^X4000
WORLD_DELETE_FLAG = ^X8000

$INIT_STATE      UFD_STATE,UFD_KEY

;+
; Read over the command name (to the first blank in the command).
;-

        $STATE      START
        $TRAN       TPA$_BLANK,,BLANKS_OFF
        $TRAN       TPA$_ANY,START

;+
; Read device name string and trailing colon.
;-

        $STATE
        $TRAN       TPA$_SYMBOL,,,,DEVICE_STRING

        $STATE
        $TRAN       ':'

;+
; Read directory string, which is either a UIC string or a general
; directory string.
;-

        $STATE
        $TRAN       !UIC,,MAKE_UIC
        $TRAN       !NAME

;+
; Scan for options until end of line is reached
;-

        $STATE      OPTIONS
        $TRAN       '/'
        $TRAN       TPA$_EOS,TPA$_EXIT

        $STATE
        $TRAN       'OWNER_UIC',PARSE_UIC,,UIC_FLAG,PARSER_FLAGS
        $TRAN       'ENTRIES',PARSE_ENTRIES,,ENTRIES_FLAG,PARSER_FLAGS
        $TRAN       'PROTECTION',PARSE_PROT,,PROT_FLAG,PARSER_FLAGS

;+
; Get file owner UIC.
;-

        $STATE      PARSE_UIC
        $TRAN       ':'
        $TRAN       '='

        $STATE
        $TRAN       !UIC,OPTIONS

```

LIB\$ Routines  
LIB\$PARSE/LIB\$TABLE\_PARSE

```

;+
; Get number of directory entries.
;-

    $STATE      PARSE_ENTRIES
    $TRAN       ':'
    $TRAN       '='

    $STATE
    $TRAN       TPA$_DECIMAL,OPTIONS,,,ENTRY_COUNT

;+
; Get directory file protection. Note that the bit masks generate the
; protection in complement form. It will be uncomplemented by the main
; program.
;-

    $STATE      PARSE_PROT
    $TRAN       ':'
    $TRAN       '='

    $STATE
    $TRAN       '('

    $STATE      NEXT_PRO
    $TRAN       'SYSTEM', SYPR
    $TRAN       'OWNER',  OWPR
    $TRAN       'GROUP',  GRPR
    $TRAN       'WORLD',  WOPR

    $STATE      SYPR
    $TRAN       ':'
    $TRAN       '='

    $STATE      SYPRO
    $TRAN       'R',SYPRO,,SYSTEM_READ_FLAG,FILE_PROTECT
    $TRAN       'W',SYPRO,,SYSTEM_WRITE_FLAG,FILE_PROTECT
    $TRAN       'E',SYPRO,,SYSTEM_EXECUTE_FLAG,FILE_PROTECT
    $TRAN       'D',SYPRO,,SYSTEM_DELETE_FLAG,FILE_PROTECT
    $TRAN       TPA$_LAMBDA,ENDPRO

    $STATE      OWPR
    $TRAN       ':'
    $TRAN       '='

    $STATE      OWPRO
    $TRAN       'R',OWPRO,,OWNER_READ_FLAG,FILE_PROTECT
    $TRAN       'W',OWPRO,,OWNER_WRITE_FLAG,FILE_PROTECT
    $TRAN       'E',OWPRO,,OWNER_EXECUTE_FLAG,FILE_PROTECT
    $TRAN       'D',OWPRO,,OWNER_DELETE_FLAG,FILE_PROTECT
    $TRAN       TPA$_LAMBDA,ENDPRO

    $STATE      GRPR
    $TRAN       ':'
    $TRAN       '='

    $STATE      GRPRO
    $TRAN       'R',GRPRO,,GROUP_READ_FLAG,FILE_PROTECT
    $TRAN       'W',GRPRO,,GROUP_WRITE_FLAG,FILE_PROTECT
    $TRAN       'E',GRPRO,,GROUP_EXECUTE_FLAG,FILE_PROTECT
    $TRAN       'D',GRPRO,,GROUP_DELETE_FLAG,FILE_PROTECT
    $TRAN       TPA$_LAMBDA,ENDPRO

    $STATE      WOPR
    $TRAN       ':'
    $TRAN       '='

```

# LIB\$ Routines

## LIB\$PARSE/LIB\$TABLE\_PARSE

```

$STATE      WOPRO
$TRAN       'R',WOPRO,,WORLD_READ_FLAG,FILE_PROTECT
$TRAN       'W',WOPRO,,WORLD_WRITE_FLAG,FILE_PROTECT
$TRAN       'E',WOPRO,,WORLD_EXECUTE_FLAG,FILE_PROTECT
$TRAN       'D',WOPRO,,WORLD_DELETE_FLAG,FILE_PROTECT
$TRAN       TPA$_LAMBDA,ENDPRO

$STATE      ENDPRO
$TRAN       '<','>',NEXT_PRO
$TRAN       ')',OPTIONS

;+
; Subexpression to parse a UIC string.
;-

$STATE      UIC
$TRAN       '['

$STATE
$TRAN       TPA$_OCTAL,,,,UIC_GROUP

$STATE
$TRAN       '<','>'      ; The comma character must be
                        ; surrounded by angle brackets
                        ; because MACRO restricts the use
                        ; of commas in arguments to macros.

$STATE
$TRAN       TPA$_OCTAL,,,,UIC_MEMBER

$STATE
$TRAN       ']',TPA$_EXIT,CHECK_UIC

;+
; Subexpression to parse a general directory string
;-

$STATE      NAME
$TRAN       '['

$STATE      NAMEO
$TRAN       TPA$_STRING,,STORE_NAME

$STATE
$TRAN       '.',NAMEO
$TRAN       ']',TPA$_EXIT
$END_STATE

.END

```

## Example 2

The following OpenVMS BLISS program accepts and parses the command line of a CREATE/DIRECTORY command using LIB\$TPARSE.

```

MODULE CREATE_DIR (                                ! Create directory file
    IDENT = 'X0000',
    MAIN = CREATE_DIR) =
BEGIN
    !+
    ! This OpenVMS BLISS program accepts and parses the command line
    ! of a CREATE/DIRECTORY command. This program uses the
    ! LIB$GET_FOREIGN call to acquire the command line from
    ! the CLI and parse it with LIB$TPARSE, leaving the necessary
    ! information in its global data base. The command line is of
    ! the following format:
    !
    !     CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
    !                   /UIC=[2437,25]
    !                   /ENTRIES=100
    !                   /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
    !
    ! The three qualifiers are optional. Alternatively, the command
    ! may take the form
    !
    !     CREATE/DIR DEVICE:[202,31]
    !
    ! using any of the optional qualifiers.
    !-
    !+
    ! Global data, control blocks, etc.
    !-

LIBRARY 'SYS$LIBRARY:STARLET';
LIBRARY 'SYS$LIBRARY:TPAMAC.L32';

    !+
    ! Macro to make the LIB$TPARSE control block addressable as a block
    ! through the argument pointer.
    !-

MACRO
    TPARSE_ARGS =
        BUILTIN AP;
        MAP AP : REF BLOCK [,BYTE];
        %;

    !+
    ! Declare routines in this module.
    !-

FORWARD ROUTINE
    CREATE_DIR,                                ! Mail program
    BLANKS_OFF,                                ! No explicit blank processing
    CHECK_UIC,                                 ! Validate and assemble UIC
    STORE_NAME,                                ! Store next directory name
    MAKE_UIC;                                  ! Make UIC into directory name

    !+
    ! Define parser flag bits for flags longword.
    !-

```

# LIB\$ Routines

## LIB\$TPARSE/LIB\$TABLE\_PARSE

```

LITERAL
    UIC_FLAG      = 0,          ! /UIC seen
    ENTRIES_FLAG  = 1,          ! /ENTRIES seen
    PROT_FLAG     = 2;         ! /PROTECTION seen

OWN
!+
! This is the LIB$GET_FOREIGN descriptor block to get the command line.
!-

    COMMAND_DESC      : BLOCK [DSC$K_S_BLN, BYTE],
    COMMAND_BUFF      : VECTOR [256, BYTE],

!+
! This is the LIB$TPARSE argument block.
!-

    TPARSE_BLOCK      : BLOCK [TPA$K_LENGTH0, BYTE]
        INITIAL (TPA$K_COUNT0, ! Longword count
                TPA$M_ABBREV    ! Allow abbreviation
                OR TPA$M_BLANKS), ! Process spaces explicitly

!+
! Parser global data:
!-

    PARSER_FLAGS      : BITVECTOR [32], ! Keyword flags
    DEVICE_STRING     : VECTOR [2],    ! Device string descriptor
    ENTRY_COUNT,      ! Space to preallocate
    FILE_PROTECT,     ! Directory file protection
    UIC_GROUP,        ! Temp for UIC group
    UIC_MEMBER,       ! Temp for UIC member
    FILE_OWNER,       ! Actual file owner UIC
    NAME_COUNT,       ! Number of directory names
    UIC_STRING        : VECTOR [6, BYTE], ! Buffer for string
    NAME_VECTOR       : BLOCKVECTOR [0, 2], ! Vector of descriptors

    DIRNAME1         : VECTOR [2],    ! Name descriptor 1
    DIRNAME2         : VECTOR [2],    ! Name descriptor 2
    DIRNAME3         : VECTOR [2],    ! Name descriptor 3
    DIRNAME4         : VECTOR [2],    ! Name descriptor 4
    DIRNAME5         : VECTOR [2],    ! Name descriptor 5
    DIRNAME6         : VECTOR [2],    ! Name descriptor 6
    DIRNAME7         : VECTOR [2],    ! Name descriptor 7
    DIRNAME8         : VECTOR [2];    ! Name descriptor 8

!+
! Structure macro to reference the descriptor fields in the vector of
! descriptors.
!-

MACRO
    STRING_COUNT      = 0, 0, 32, 0%, ! Count field
    STRING_ADDR       = 1, 0, 32, 0%; ! Address field

!+
! LIB$TPARSE state table to parse the command line
!-

$INIT_STATE          (UFD_STATE, UFD_KEY);

!+
! Read over the command name (to the first blank in the command).
!-

```

**LIB\$ Routines**  
**LIB\$PARSE/LIB\$TABLE\_PARSE**

```

$STATE (START,
        (TPA$_BLANK, , BLANKS_OFF),
        (TPA$_ANY, START)
        );
!+
! Read device name string and trailing colon.
!-

$STATE (,
        (TPA$_SYMBOL,,,, DEVICE_STRING)
        );

$STATE (,
        (':')
        );

!+
! Read directory string, which is either a UIC string or a general
! directory string.
!-

$STATE (,
        ((UIC),, MAKE_UIC),
        ((NAME))
        );

!+
! Scan for options until end of line is reached.
!-

$STATE (OPTIONS,
        ('/'),
        (TPA$_EOS, TPA$_EXIT)
        );

$STATE (,
        ('UIC', PARSE_UIC,, 1^UIC_FLAG, PARSE_FLAGS),
        ('ENTRIES', PARSE_ENTRIES,, 1^ENTRIES_FLAG, PARSE_FLAGS),
        ('PROTECTION', PARSE_PROT,, 1^PROT_FLAG, PARSE_FLAGS)
        );

!+
! Get file owner UIC.
!-

$STATE (PARSE_UIC,
        (':'),
        ('=')
        );

$STATE (,
        ((UIC), OPTIONS)
        );

!+
! Get number of directory entries.
!-

$STATE (PARSE_ENTRIES,
        (':'),
        ('=')
        );

$STATE (,
        (TPA$_DECIMAL, OPTIONS,,, ENTRY_COUNT)
        );

```

# LIB\$ Routines

## LIB\$TPARSE/LIB\$TABLE\_PARSE

```
!+
! Get directory file protection. Note that the bit masks generate the
! protection in complement form. It will be uncomplemented by the main
! program.
!-

$STATE (PARSE_PROT,
        (':'),
        ('='),
        );

$STATE (,
        ('(')
        );

$STATE (NEXT_PRO,
        ('SYSTEM', SYPR),
        ('OWNER', OWPR),
        ('GROUP', GRPR),
        ('WORLD', WOPR)
        );

$STATE (SYPR,
        (':'),
        ('='),
        );

$STATE (SYPRO,
        ('R', SYPRO,, %X'0001', FILE_PROTECT),
        ('W', SYPRO,, %X'0002', FILE_PROTECT),
        ('E', SYPRO,, %X'0004', FILE_PROTECT),
        ('D', SYPRO,, %X'0008', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE (OWPR,
        (':'),
        ('='),
        );

$STATE (OWPRO,
        ('R', OWPRO,, %X'0010', FILE_PROTECT),
        ('W', OWPRO,, %X'0020', FILE_PROTECT),
        ('E', OWPRO,, %X'0040', FILE_PROTECT),
        ('D', OWPRO,, %X'0080', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE (GRPR,
        (':'),
        ('='),
        );

$STATE (GRPRO,
        ('R', GRPRO,, %X'0100', FILE_PROTECT),
        ('W', GRPRO,, %X'0200', FILE_PROTECT),
        ('E', GRPRO,, %X'0400', FILE_PROTECT),
        ('D', GRPRO,, %X'0800', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE (WOPR,
        (':'),
        ('='),
        );
```

# LIB\$ Routines

## LIB\$TPARSE/LIB\$TABLE\_PARSE

```

$STATE (WOPRO,
        ('R', WOPRO,, %X'1000', FILE_PROTECT),
        ('W', WOPRO,, %X'2000', FILE_PROTECT),
        ('E', WOPRO,, %X'4000', FILE_PROTECT),
        ('D', WOPRO,, %X'8000', FILE_PROTECT),
        (TPA$_LAMBDA, ENDPRO)
        );

$STATE (ENDPRO,
        (',', ' ', NEXT_PRO),
        (')', OPTIONS)
        );

!+
! Subexpression to parse a UIC string.
!-

$STATE (UIC,
        ('[')
        );

$STATE (,
        (TPA$ _OCTAL,,,, UIC_GROUP)
        );

$STATE (,
        (',', ')
        );

$STATE (,
        (TPA$ _OCTAL,,,, UIC_MEMBER)
        );

$STATE (,
        (']', TPA$ _EXIT, CHECK_UIC)
        );

!+
! Subexpression to parse a general directory string
!-

$STATE (NAME,
        ('[')
        );

$STATE (NAME0,
        (TPA$ _STRING,, STORE_NAME)
        );

$STATE (,
        ('.', NAME0),
        (']', TPA$ _EXIT)
        );

PSECT OWN = $OWN$;
PSECT GLOBAL = $GLOBAL$;

GLOBAL ROUTINE CREATE_DIR (START_ADDR, CLI_CALLBACK) =
BEGIN
!+
! This program creates a directory. It gets the command
! line from the CLI and parses it with LIB$TPARSE.
!-

LOCAL
    STATUS,                ! Status from LIB$TPARSE
    OUT_LEN : WORD;        ! length of returned command line
EXTERNAL
    SS$ _NORMAL;

```

# LIB\$ Routines

## LIB\$TPARSE/LIB\$TABLE\_PARSE

EXTERNAL ROUTINE

```
LIB$GET_FOREIGN : ADDRESSING_MODE (GENERAL),
LIB$TPARSE      : ADDRESSING_MODE (GENERAL);

COMMAND_DESC [DSC$W_LENGTH] = 256;
COMMAND_DESC [DSC$B_DTYPE]  = DSC$K_DTYPE_T;
COMMAND_DESC [DSC$B_CLASS]  = DSC$K_CLASS_S;
COMMAND_DESC [DSC$A_POINTER] = COMMAND_BUFF;
```

```
STATUS = LIB$GET_FOREIGN (COMMAND_DESC,
                          %ASCID'COMMAND: ',
                          OUT_LEN
                          );
```

```
IF NOT .STATUS
THEN
    SIGNAL (STATUS);
```

!+

! Copy the input string descriptor into the LIB\$TPARSE control block  
! and call LIB\$TPARSE. Note that impure storage is assumed to be zero.

!-

```
TPARSE_BLOCK[TPA$L_STRINGCNT] = .OUT_LEN;
TPARSE_BLOCK[TPA$L_STRINGPTR] = .COMMAND_DESC[DSC$A_POINTER];
```

```
STATUS = LIB$TPARSE (TPARSE_BLOCK, UFD_STATE, UFD_KEY);
```

```
IF NOT .STATUS
```

```
THEN
```

```
    RETURN 0;
```

```
RETURN SS$NORMAL
```

```
END;
```

! End of routine CREATE\_DIR

!+

! Parser action routines

!-

!+

! Shut off explicit blank processing after passing the command name.

!-

```
ROUTINE BLANKS_OFF =
```

```
    BEGIN
```

```
    TPARSE_ARGS;
```

```
    AP[TPA$V_BLANKS] = 0;
```

```
    1
```

```
    END;
```

!+

! Check the UIC for legal value range.

!-

```
ROUTINE CHECK_UIC =
```

```
    BEGIN
```

```
    TPARSE_ARGS;
```

```
    IF .UIC_GROUP<16,16> NEQ 0
```

```
    OR .UIC_MEMBER<16,16> NEQ 0
```

```
    THEN RETURN 0;
```

```
    FILE_OWNER<0,16> = .UIC_MEMBER;
```

```
    FILE_OWNER<16,16> = .UIC_GROUP;
```

```
    1
```

```
    END;
```

!+

! Store a directory name component.

!-

LIB\$ Routines  
LIB\$PARSE/LIB\$TABLE\_PARSE

```
ROUTINE STORE_NAME =
  BEGIN
    TPARSE_ARGS;

    IF .NAME_COUNT GEQU 8
    OR .AP[TPA$L_TOKENCNT] GTRU 9
    THEN RETURN 0;
    NAME_COUNT = .NAME_COUNT + 1;
    NAME_VECTOR [.NAME_COUNT, STRING_COUNT] = .AP[TPA$L_TOKENCNT];
    NAME_VECTOR [.NAME_COUNT, STRING_ADDR] = .AP[TPA$L_TOKENPTR];
    1
  END;

!+
! Convert a UIC into its equivalent directory file name.
!-

ROUTINE MAKE_UIC =
  BEGIN
    TPARSE_ARGS;

    IF .UIC_GROUP<8,8> NEQ 0
    OR .UIC_MEMBER<8,8> NEQ 0
    THEN RETURN 0;
    DIRNAME1[0] = 0;
    DIRNAME1[1] = UIC_STRING;
    $FAOL (CTRSTR = UPLIT (6, UPLIT BYTE ('!OB!OB')),
          OUTBUF = DIRNAME1,
          PRMLST = UIC_GROUP
          );
    1
  END;
ELUDOM                                     ! End of module CREATE_DIR
```

## LIB\$ Routines

### LIB\$PARSE/LIB\$TABLE\_PARSE

#### Example 3

The following MACRO assembly language program accepts and parses the command line of a CREATE/DIRECTORY command using LIB\$PARSE. It also defines the state table for the parser.

```

        .TITLE          CREATE_DIR - Create Directory File
        .IDENT          "X0000"
;+
;
; This is a sample OpenVMS MACRO program that accepts and parses the command
; line of the CREATE/DIRECTORY command. This program contains the OpenVMS
; call to acquire the command line from the command interpreter
; and parse it with LIB$PARSE, leaving the necessary information in
; its global data base. The command line has the following format:
;
;         CREATE/DIR DEVICE:[MARANTZ.ACCOUNT.OLD]
;                /OWNER UIC=[2437,25]
;                /ENTRIES=100
;                /PROTECTION=(SYSTEM:R,OWNER:RWED,GROUP:R,WORLD:R)
;
; The three qualifiers are optional. Alternatively, the command
; may take the form
;
;         CREATE/DIR DEVICE:[202,31]
;
; using any of the optional qualifiers.
;
;-
;+
;
; Global data, control blocks, etc.
;
;-
        .PSECT  IMPURE,WRT,NOEXE
;+
; Define control block offsets
;-
        $CLIDEF
        $TPADEF
;+
; Define parser flag bits for flags longword
;-
UIC_FLAG          = 1          ; /UIC seen
ENTRIES_FLAG      = 2          ; /ENTRIES seen
PROT_FLAG         = 4          ; /PROTECTION seen
;+
; LIB$GET_FOREIGN string descriptors to get the line to be parsed
;-
STRING_LEN = 256
STRING_DESC:
        .WORD STRING_LEN
        .BYTE DSC$K_DTYPE_T
        .BYTE DSC$K_CLASS_S
        .ADDRESS STRING_AREA
STRING_AREA:
        .BLKB STRING_LEN
PROMPT_DESC:
        .WORD PROMPT_LEN
        .BYTE DSC$K_DTYPE_T
        .BYTE DSC$K_CLASS_S
        .ADDRESS PROMPT

```

**LIB\$ Routines**  
**LIB\$TPARSE/LIB\$TABLE\_PARSE**

```

PROMPT:
    .ASCII /qualifiers: /
PROMPT_LEN = .-PROMPT

;+
; TPARSE argument block
;-

TPARSE_BLOCK:
    .LONG      TPA$K_COUNT0      ; Longword count
    .LONG      TPA$M_ABBREV!-    ; Allow abbreviation
    .LONG      TPA$M_BLANKS     ; Process spaces explicitly
    .BLKB      TPA$K_LENGTH0-8   ; Remainder set at run time

;+
; Parser global data
;-

RET_LEN:      .BLKW      1      ; LENGTH OF RETURNED COMMAND LINE
PARSER_FLAGS: .BLKL      1      ; Keyword flags
DEVICE_STRING: .BLKL      2      ; Device string descriptor
ENTRY_COUNT:  .BLKL      1      ; Space to preallocate
FILE_PROTECT: .BLKL      1      ; Directory file protection
UIC_GROUP:    .BLKL      1      ; Temp for UIC group
UIC_MEMBER:   .BLKL      1      ; Temp for UIC member
UIC_STRING:   .BLKB      6      ; String to receive converted UIC
FILE_OWNER:   .BLKL      1      ; Actual file owner UIC
NAME_COUNT:   .BLKL      1      ; Number of directory names
DIRNAME1:     .BLKL      2      ; Name descriptor 1
DIRNAME2:     .BLKL      2      ; Name descriptor 2
DIRNAME3:     .BLKL      2      ; Name descriptor 3
DIRNAME4:     .BLKL      2      ; Name descriptor 4
DIRNAME5:     .BLKL      2      ; Name descriptor 5
DIRNAME6:     .BLKL      2      ; Name descriptor 6
DIRNAME7:     .BLKL      2      ; Name descriptor 7
DIRNAME8:     .BLKL      2      ; Name descriptor 8

    .SBTTL Main Program

;+
; This program gets the CREATE/DIRECTORY command line from
; the command interpreter and parses it.
;-

    .PSECT CODE,EXE,NOWRT
CREATE_DIR::
    .WORD      ^M<R2,R3,R4,R5>      ; Save registers

;+
; Call the command interpreter to obtain the command line.
;-

    PUSHAW    RET_LEN
    PUSHAQ    PROMPT_DESC
    PUSHAQ    STRING_DESC
    CALLS     #3,G^LIB$GET_FOREIGN    ; Call to get command line
    BLBC      R0, SYNTAX_ERR

;+
; Copy the input string descriptor into the TPARSE control block
; and call LIB$TPARSE. Note that impure storage is assumed to be zero.
;-

    MOVZWL    RET_LEN, TPARSE_BLOCK+TPA$L_STRINGCNT
    MOVAL     STRING_AREA, TPARSE_BLOCK+TPA$L_STRINGPTR
    PUSHAL    UFD_KEY
    PUSHAL    UFD_STATE
    PUSHAL    TPARSE_BLOCK
    CALLS     #3,G^LIB$TPARSE
    BLBC      R0, SYNTAX_ERR

```

# LIB\$ Routines

## LIB\$PARSE/LIB\$TABLE\_PARSE

```

;+
; Parsing is complete.
;
; You can include here code to process the string just parsed, to call
; another program to process the command, or to return control to
; a calling program, if any.
;-

SYNTAX_ERR:

;+
; Code to handle parsing errors.
;-

        RET

        .SBTTL          Parser State Table

;+
; Assign values for protection flags to be used when parsing protection
; string.
;-

SYSTEM_READ_FLAG = ^X0001
SYSTEM_WRITE_FLAG = ^X0002
SYSTEM_EXECUTE_FLAG = ^X0004
SYSTEM_DELETE_FLAG = ^X0008
OWNER_READ_FLAG = ^X0010
OWNER_WRITE_FLAG = ^X0020
OWNER_EXECUTE_FLAG = ^X0040
OWNER_DELETE_FLAG = ^X0080
GROUP_READ_FLAG = ^X0100
GROUP_WRITE_FLAG = ^X0200
GROUP_EXECUTE_FLAG = ^X0400
GROUP_DELETE_FLAG = ^X0800
WORLD_READ_FLAG = ^X1000
WORLD_WRITE_FLAG = ^X2000
WORLD_EXECUTE_FLAG = ^X4000
WORLD_DELETE_FLAG = ^X8000

$INIT_STATE      UFD_STATE,UFD_KEY

;+
; Read over the command name (to the first blank in the command).
;-
        $STATE      START
        $TRAN       TPA$_BLANK,,BLANKS_OFF
        $TRAN       TPA$_ANY,START

;+
; Read device name string and trailing colon.
;-
        $STATE
        $TRAN       TPA$_SYMBOL,,,,DEVICE_STRING

        $STATE
        $TRAN       ':'

;+
; Read directory string, which is either a UIC string or a general
; directory string.
;-
        $STATE
        $TRAN       !UIC,,MAKE_UIC
        $TRAN       !NAME

;+
; Scan for options until end of line is reached
;-

```

**LIB\$ Routines**  
**LIB\$PARSE/LIB\$TABLE\_PARSE**

```

$STATE      OPTIONS
$STRAN      '/'
$STRAN      TPA$ _EOS,TPA$ _EXIT

$STATE
$STRAN      'OWNER_UIC',PARSE_UIC,,UIC_FLAG,PARSER_FLAGS
$STRAN      'ENTRIES',PARSE_ENTRIES,,ENTRIES_FLAG,PARSER_FLAGS
$STRAN      'PROTECTION',PARSE_PROT,,PROT_FLAG,PARSER_FLAGS

;+
; Get file owner UIC.
;-
$STATE      PARSE_UIC
$STRAN      ':'
$STRAN      '='

$STATE
$STRAN      !UIC,OPTIONS

;+
; Get number of directory entries.
;-
$STATE      PARSE_ENTRIES
$STRAN      ':'
$STRAN      '='

$STATE
$STRAN      TPA$ _DECIMAL,OPTIONS,,,ENTRY_COUNT

;+
; Get directory file protection. Note that the bit masks generate the
; protection in complement form. It will be uncomplemented by the main
; program.
;-
$STATE      PARSE_PROT
$STRAN      ':'
$STRAN      '='

$STATE
$STRAN      '('

$STATE      NEXT_PRO
$STRAN      'SYSTEM', SYPR
$STRAN      'OWNER', OWPR
$STRAN      'GROUP', GRPR
$STRAN      'WORLD', WOPR

$STATE      SYPR
$STRAN      ':'
$STRAN      '='

$STATE      SYPRO
$STRAN      'R',SYPRO,,SYSTEM_READ_FLAG,FILE_PROTECT
$STRAN      'W',SYPRO,,SYSTEM_WRITE_FLAG,FILE_PROTECT
$STRAN      'E',SYPRO,,SYSTEM_EXECUTE_FLAG,FILE_PROTECT
$STRAN      'D',SYPRO,,SYSTEM_DELETE_FLAG,FILE_PROTECT
$STRAN      TPA$ _LAMBDA,ENDPRO

$STATE      OWPR
$STRAN      ':'
$STRAN      '='

$STATE      OWPRO
$STRAN      'R',OWPRO,,OWNER_READ_FLAG,FILE_PROTECT
$STRAN      'W',OWPRO,,OWNER_WRITE_FLAG,FILE_PROTECT
$STRAN      'E',OWPRO,,OWNER_EXECUTE_FLAG,FILE_PROTECT
$STRAN      'D',OWPRO,,OWNER_DELETE_FLAG,FILE_PROTECT
$STRAN      TPA$ _LAMBDA,ENDPRO

```

# LIB\$ Routines

## LIB\$PARSE/LIB\$TABLE\_PARSE

```

$STATE      GRPR
$STRAN      ':'
$STRAN      '='

$STATE      GRPRO
$STRAN      'R',GRPRO,,GROUP_READ_FLAG,FILE_PROTECT
$STRAN      'W',GRPRO,,GROUP_WRITE_FLAG,FILE_PROTECT
$STRAN      'E',GRPRO,,GROUP_EXECUTE_FLAG,FILE_PROTECT
$STRAN      'D',GRPRO,,GROUP_DELETE_FLAG,FILE_PROTECT
$STRAN      TPA$_LAMBDA,ENDPRO

$STATE      WOPR
$STRAN      ':'
$STRAN      '='

$STATE      WOPRO
$STRAN      'R',WOPRO,,WORLD_READ_FLAG,FILE_PROTECT
$STRAN      'W',WOPRO,,WORLD_WRITE_FLAG,FILE_PROTECT
$STRAN      'E',WOPRO,,WORLD_EXECUTE_FLAG,FILE_PROTECT
$STRAN      'D',WOPRO,,WORLD_DELETE_FLAG,FILE_PROTECT
$STRAN      TPA$_LAMBDA,ENDPRO

$STATE      ENDPRO
$STRAN      '<','>',NEXT PRO
$STRAN      ')',OPTIONS
;+
; Subexpression to parse a UIC string.
;-

$STATE      UIC
$STRAN      '['

$STATE      TPA$_OCTAL,,,,UIC_GROUP
$STRAN      TPA$_OCTAL,,,,UIC_GROUP

$STATE      '<','>'
$STRAN      '<','>' ; The comma character must be
                  ; surrounded by angle brackets
                  ; because MACRO restricts the use
                  ; of commas in arguments to macros.

$STATE      TPA$_OCTAL,,,,UIC_MEMBER
$STRAN      TPA$_OCTAL,,,,UIC_MEMBER

$STATE      ']',TPA$_EXIT,CHECK_UIC
$STRAN      ']',TPA$_EXIT,CHECK_UIC

;+
; Subexpression to parse a general directory string
;-

$STATE      NAME
$STRAN      '['

$STATE      NAMEO
$STRAN      TPA$_STRING,,STORE_NAME

$STATE      ']',NAMEO
$STRAN      ']',TPA$_EXIT
$END_STATE

.SBTTL      Parser Action Routines
.PSECT      CODE,EXE,NOWRT

;+
; Shut off explicit blank processing after passing the command name.
;-

```

**LIB\$ Routines**  
**LIB\$PARSE/LIB\$TABLE\_PARSE**

```

BLANKS_OFF:
    .WORD      0                ; No registers saved (or used)
    BCC        #TPA$V_BLANKS,TPA$L_OPTIONS(AP),10$
10$:  RET

;+
; Check the UIC for legal value range.
;-

CHECK_UIC:
    .WORD      0                ; No registers saved (or used)
    TSTW      UIC_GROUP+2      ; UIC components are 16 bits
    BNEQ      10$
    TSTW      UIC_MEMBER+2
    BNEQ      10$
    MOVW      UIC_GROUP,FILE_OWNER+2 ; Store actual UIC
    MOVW      UIC_MEMBER,FILE_OWNER ; after checking
    RET
10$:  CLRL    R0                ; Value out of range - fail
    RET        ; the transition

;+
; Store a directory name component.
;-

STORE_NAME:
    .WORD      0                ; No registers saved (or used)
    MOVL      NAME_COUNT,R1     ; Get count of names so far
    CMLPL     R1,#8             ; Maximum of 8 permitted
    BGEQU     10$
    INCL      NAME_COUNT        ; Count this name
    MOVAQ     DIRNAME1[R1],R1    ; Address of next descriptor
    MOVQ      TPA$L_TOKENCNT(AP),(R1) ; Store the descriptor
    CMLPL     (R1),#9           ; Check the length of the name
    BGTRU     10$              ; Maximum is 9
    RET
10$:  CLRL    R0                ; Error in directory name
    RET

;+
; Convert a UIC into its equivalent directory file name.
;-

MAKE_UIC:
    .WORD      0                ; No registers saved (or used)
    TSTB      UIC_GROUP+1      ; Check UIC for byte values,
    BNEQ      10$              ; Since UIC type directories
    TSTB      UIC_MEMBER+1     ; Are restricted to this form
    BNEQ      10$
    MOVL      #6,DIRNAME1      ; Directory name is 6 bytes
    MOVAL     UIC_STRING,DIRNAME1+4 ; Point to string buffer
    $FAOL     CTR$STR=FAO_STRING,- ; Convert UIC to octal string
    OUTBUF=DIRNAME1,-
    PRMLST=UIC_GROUP

    RET
10$:  CLRL    R0                ; Range error - fail it
    RET

FAO_STRING: .LONG      STRING_END-STRING_START
STRING_START: .ASCII  '!OB!OB'
STRING_END:

    .END      CREATE_DIR

```

---

## LIB\$TRAVERSE\_TREE

### Traverse a Balanced Binary Tree

The Traverse a Balanced Binary Tree routine calls an action routine for each node in a binary tree.†

#### Format

LIB\$TRAVERSE\_TREE treehead ,user-action-procedure [,user-data-address]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### treehead

OpenVMS usage: address  
type: address  
access: read only  
mechanism: by reference

Tree head of the binary tree. The **treehead** argument is the address of an unsigned longword that is the tree head in the binary tree traversal.

##### user-action-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied action routine called by LIB\$TRAVERSE\_TREE for each node in the tree. The **user-action-procedure** argument must return a success status for LIB\$TRAVERSE\_TREE to continue traversal.

For more information, see Call Format for an Action Routine in the Description section.

##### user-data-address

OpenVMS usage: user\_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

User data that LIB\$TRAVERSE\_TREE passes to your action routine. The **user-data-address** argument contains the address of this user data. This is an optional argument; the default value is 0.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## Description

LIB\$TRAVERSE\_TREE calls a user-supplied action routine for each node to traverse a balanced binary tree.

### Call Format for an Action Routine

The format of the call is as follows:

**user-action-procedure** node ,user-data-address

LIB\$TRAVERSE\_TREE passes the **node** and **user-data-address** arguments to your action routine by reference.

This action routine is defined by you to fit your own purposes. A common use of an action routine here is to print the contents of each node during the tree traversal.

The following is one example of a user-supplied action routine.

```
struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Print_Node(struct Full_node* Node, void* dummy)
{
    /*
    ** Print the string contained in the current node
    */
    printf("%s\n", Node->Text);
    return LIB$NORMAL;
}
```

## Condition Values Returned

LIB\$NORMAL                      Routine successfully completed.

Any condition value returned by your action routine.

## Example

The C example provided in the description of LIB\$INSERT\_TREE also demonstrates the use of LIB\$TRAVERSE\_TREE. Refer to that example for assistance in using this routine.

## LIB\$ Routines

### LIB\$TRAVERSE\_TREE\_64 (Alpha Only)

---

## LIB\$TRAVERSE\_TREE\_64 (Alpha Only)

### Traverse a Balanced Binary Tree

The Traverse a Balanced Binary Tree routine calls an action routine for each node in a binary tree.

#### Format

```
LIB$TRAVERSE_TREE_64 treehead ,user-action-procedure [,user-data-address]
```

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### treehead

OpenVMS usage: address  
type: address  
access: read only  
mechanism: by reference

Tree head of the binary tree. The **treehead** argument is the address of an unsigned quadword that is the tree head in the binary tree traversal.

##### user-action-procedure

OpenVMS usage: procedure  
type: procedure value  
access: function call (before return)  
mechanism: by value

User-supplied action routine called by LIB\$TRAVERSE\_TREE\_64 for each node in the tree. The **user-action-procedure** argument must return a success status for LIB\$TRAVERSE\_TREE\_64 to continue traversal.

For more information, see Call Format for an Action Routine in the Description section.

##### user-data-address

OpenVMS usage: user\_arg  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

User data that LIB\$TRAVERSE\_TREE\_64 passes to your action routine. The **user-data-address** argument contains the address of this user data. This is an optional argument; the default value is 0.

## Description

LIB\$TRAVERSE\_TREE\_64 calls a user-supplied action routine for each node to traverse a balanced binary tree.

### Call Format for an Action Routine

The format of the call is as follows:

**user-action-procedure** node ,user-data-address

LIB\$TRAVERSE\_TREE\_64 passes the **node** and **user-data-address** arguments to your action routine by reference.

This action routine is defined by you to fit your own purposes. A common use of an action routine here is to print the contents of each node during the tree traversal.

The following is one example of a user-supplied action routine.

```
struct Full_node
{
    void* left_link;
    void* right_link;
    short reserved;
    char Text[80];
};

static long Print_Node(struct Full_node* Node, void* dummy)
{
    /*
    ** Print the string contained in the current node
    */
    printf("%s\n", Node->Text);
    return LIB$NORMAL;
}
```

## Condition Values Returned

LIB\$NORMAL                      Routine successfully completed.

Any condition value returned by your action routine.

## Example

The C example provided in the description of LIB\$INSERT\_TREE\_64 also demonstrates the use of LIB\$TRAVERSE\_TREE\_64. Refer to that example for assistance in using this routine.

---

## LIB\$TRA\_ASC\_EBC

### Translate ASCII to EBCDIC

The Translate ASCII to EBCDIC routine translates an ASCII string to an EBCDIC string.

#### Format

LIB\$TRA\_ASC\_EBC source-string ,byte-integer-dest-string

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### source-string

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Source string (ASCII) to be translated by LIB\$TRA\_ASC\_EBC. The **source-string** argument contains the address of a descriptor pointing to this source string.

##### byte-integer-dest-string

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string (EBCDIC). The **byte-integer-dest-string** argument contains the address of a descriptor pointing to this destination string.

#### Description

LIB\$TRA\_ASC\_EBC translates an ASCII string to an EBCDIC string. If the destination string is a fixed-length string, its length must match the length of the input string. The length of both the source and destination strings is limited to 65,535 characters. No filling is done.

A similar operation can be accomplished by specifying the ASCII to EBCDIC translation table, LIB\$AB\_ASC\_EBC, in a routine using LIB\$MOVTC, but no testing for untranslatable characters is done under those circumstances.

The LIB\$TRA\_ASC\_EBC routine uses the ASCII to EBCDIC translation table.

**ASCII to EBCDIC Translation Table**

- The numbers on the left represent the low-order bits of the ASCII characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the ASCII characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent EBCDIC characters in hexadecimal notation.

Figure LIB-24 is the ASCII to EBCDIC translation table.

**Figure LIB-24 LIB\$AB\_ASC\_EBC**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 40 | F0 | 7C | D7 | 79 | 97 | 3F |
| 1                 | 01                   | 11 | 4F | F1 | C1 | D8 | 81 | 98 | 3F |
| 2                 | 02                   | 12 | 7F | F2 | C2 | D9 | 82 | 99 | 3F |
| 3                 | 03                   | 13 | 7B | F3 | C3 | E2 | 83 | A2 | 3F |
| 4                 | 37                   | 3C | 5B | F4 | C4 | E3 | 84 | A3 | 3F |
| 5                 | 2D                   | 3D | 6C | F5 | C5 | E4 | 85 | A4 | 3F |
| 6                 | 2E                   | 32 | 50 | F6 | C6 | E5 | 86 | A5 | 3F |
| 7                 | 2F                   | 26 | 7D | F7 | C7 | E6 | 87 | A6 | 3F |
| 8                 | 16                   | 18 | 4D | F8 | C8 | E7 | 88 | A7 | 3F |
| 9                 | 05                   | 19 | 5D | F9 | C9 | E8 | 89 | A8 | 3F |
| A                 | 25                   | 3F | 5C | 7A | D1 | E9 | 91 | A9 | 3F |
| B                 | 0B                   | 27 | 4E | 5E | D2 | 4A | 92 | C0 | 3F |
| C                 | 0C                   | 1C | 6B | 4C | D3 | E0 | 93 | 6A | 3F |
| D                 | 0D                   | 1D | 60 | 7E | D4 | 5A | 94 | D0 | 3F |
| E                 | 0E                   | 1E | 4B | 6E | D5 | 5F | 95 | A1 | 3F |
| F                 | 0F                   | 1F | 61 | 6F | D6 | 6D | 96 | 07 | 3F | FF |

ZK-4246-GE

All ASCII graphics are translated to their equivalent EBCDIC graphics except for the graphics noted in Table LIB-13.

**Table LIB-13 ASCII Graphics Not Translated to EBCDIC Equivalent by LIB\$TRA\_ASC\_EBC**

| ASCII Graphic            | EBCDIC Graphic        |
|--------------------------|-----------------------|
| [ (left square bracket)  | ¢ (cents sign)        |
| ! (exclamation point)    | (short vertical bar)  |
| ^ (circumflex)           | ¬ (logical not)       |
| ] (right square bracket) | ! (exclamation point) |

**Condition Values Returned**

SS\$\_NORMAL

Routine successfully completed.

## LIB\$ Routines LIB\$TRA\_ASC\_EBC

|              |   |
|--------------|---|
| LIB\$_INVCHA | One or more occurrences of an untranslatable character have been detected during the translation.   |
| LIB\$_INVARG | If the destination string is a fixed-length string and its length is not the same as the source string length, or if the length of the input string is greater than 65,535 characters, no translation is attempted. |

### Example

This COBOL program uses LIB\$TRA\_ASC\_EBC to translate an ASCII string to EBCDIC. If successful, it then uses LIB\$MOVTC to translate the EBCDIC string back to ASCII.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. TRANS.

ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.
01 INPUT-STRING PIC X(4).
01 EBCDIC-STRING PIC X(4).
01 OUT-STRING PIC X(4).
01 FILL-CHAR PIC X VALUE "@".
01 SS-STATUS PIC S9(9) COMP.
88 SS-NORMAL VALUE 01.

01 EBCDIC-TABLE.
05 FILLER PIC X(16) VALUE "aaaaaaaaaaaaaaaaaaaa".
05 FILLER PIC X(16) VALUE "bbbbbbbbbbbbbbbbbbbb".
05 FILLER PIC X(16) VALUE "cccccccccccccccccccc".
05 FILLER PIC X(16) VALUE "ddddddddddddddddcccc".
05 FILLER PIC X(16) VALUE " eeeeeeeeeeee.<(+|".
05 FILLER PIC X(16) VALUE "&eeeeeeeeeee!$*);e".
05 FILLER PIC X(16) VALUE "-/eeeeeeeeeee,% >?".
05 FILLER PIC X(16) VALUE "eeeeeeeeeee:#e^="".
05 FILLER PIC X(16) VALUE "abcdefghiieeeeeee".
05 FILLER PIC X(16) VALUE "jklmnopqrreeeeeee".
05 FILLER PIC X(16) VALUE "estuvwxyzeeeeeee".
05 FILLER PIC X(16) VALUE "eeeeeeeeeeeeeeeeeeee".
05 FILLER PIC X(16) VALUE "@ABCDEFGHIIEeeeeeee".
05 FILLER PIC X(16) VALUE "!JKLMNOPQReeeeeeee".
05 FILLER PIC X(16) VALUE "eESTUVWXYZeeeeeee".
05 FILLER PIC X(16) VALUE "0123456789eeeeeeee".

ROUTINE DIVISION.

001-MAIN.
DISPLAY " ".
DISPLAY "ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC: "
WITH NO ADVANCING.
ACCEPT INPUT-STRING
AT END STOP RUN.
IF INPUT-STRING = "EXIT" OR "exit" OR " "
STOP RUN.
```

LIB\$ Routines  
LIB\$TRA\_ASC\_EBC

```
CALL "LIB$TRA ASC EBC"  
  USING BY DESCRIPTOR INPUT-STRING, EBCDIC-STRING  
  GIVING SS-STATUS.  
IF SS-NORMAL  
  CALL "LIB$MOVTC"  
  USING BY DESCRIPTOR EBCDIC-STRING,  
    FILL-CHAR,  
    EBCDIC-TABLE,  
    OUT-STRING,  
  GIVING SS-STATUS  
  IF SS-NORMAL  
  DISPLAY "ASCII ENTERED WAS: " INPUT-STRING  
  DISPLAY "EBCDIC TRANSLATED IS: " OUT-STRING  
  ELSE  
  DISPLAY "*** LIB$MOVTC TRANSLATION UNSUCCESSFUL ***"  
ELSE  
  DISPLAY "*** LIB$TRA_ASC_EBC TRANSLATION UNSUCCESSFUL ***".  
GO TO 001-MAIN.
```

To exit from this program, you must press Ctrl/Z. The output generated by this COBOL program is as follows:

\$ RUN TRANS

```
ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  abdc  
ASCII ENTERED WAS:  abdc  
EBCDIC TRANSLATED IS:  abdc
```

```
ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  ~=b&  
ASCII ENTERED WAS:  ~=b&  
EBCDIC TRANSLATED IS:  @=b&
```

```
ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  8^%$  
ASCII ENTERED WAS:  8^%$  
EBCDIC TRANSLATED IS:  8@%$
```

```
ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  
/x\  
ASCII ENTERED WAS:  /x\  
EBCDIC TRANSLATED IS:  /x@!
```

```
ENTER 4 CHARACTERS TO BE TRANSLATED ASCII TO EBCDIC:  Ctrl/Z
```

## LIB\$TRA\_EBC\_ASC Translate EBCDIC to ASCII

The Translate EBCDIC to ASCII routine translates an EBCDIC string to an ASCII string.

### Format

LIB\$TRA\_EBC\_ASC byte-integer-source-string ,destination-string

### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: read only  
mechanism: by value

### Arguments

#### **byte-integer-source-string**

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

String (EBCDIC) to be translated by LIB\$TRA\_EBC\_ASC. The **byte-integer-source-string** argument contains the address of a descriptor pointing to this source string.

#### **destination-string**

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Destination string (ASCII). The **destination-string** argument contains the address of the descriptor of this destination string.

The LIB\$TRA\_EBC\_ASC routine uses the EBCDIC to ASCII translation table, LIB\$AB\_EBC\_ASC.

### Description

LIB\$TRA\_EBC\_ASC translates an EBCDIC string to an ASCII string. If the destination string is a fixed-length string, its length must match the length of the input string. The length of both the source and destination strings is limited to 65,535 characters. No filling is done.

A similar operation can be accomplished by specifying the EBCDIC to ASCII translation table, LIB\$AB\_EBC\_ASC, in a routine using LIB\$MOVTC, but no testing for untranslatable characters is done under these circumstances.

The LIB\$TRA\_EBC\_ASC routine uses the EBCDIC to ASCII translation shown in Figure LIB-25.

**Figure LIB-25 LIB\$AB\_EBC\_ASC**

| Row<br>Bits 0 - 3 | Column<br>Bits 4 - 7 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                   | 0                    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | A  | B  | C  | D  | E  | F  |
| 0                 | 00                   | 10 | 5C | 5C | 20 | 26 | 2D | 5C | 5C | 5C | 5C | 5C | 7B | 7D | 5C | 30 |
| 1                 | 01                   | 11 | 5C | 5C | 5C | 5C | 2F | 5C | 61 | 6A | 7E | 5C | 41 | 4A | 5C | 31 |
| 2                 | 02                   | 12 | 5C | 16 | 5C | 5C | 5C | 5C | 62 | 6B | 73 | 5C | 42 | 4B | 53 | 32 |
| 3                 | 03                   | 13 | 5C | 5C | 5C | 5C | 5C | 5C | 63 | 6C | 74 | 5C | 43 | 4C | 54 | 33 |
| 4                 | 5C                   | 5C | 5C | 5C | 5C | 5C | 5C | 5C | 64 | 6D | 75 | 5C | 44 | 4D | 55 | 34 |
| 5                 | 09                   | 5C | 0A | 5C | 5C | 5C | 5C | 5C | 65 | 6E | 76 | 5C | 45 | 4E | 56 | 35 |
| 6                 | 5C                   | 08 | 17 | 5C | 5C | 5C | 5C | 5C | 66 | 6F | 77 | 5C | 46 | 4F | 57 | 36 |
| 7                 | 7F                   | 5C | 1B | 04 | 5C | 5C | 5C | 5C | 67 | 70 | 78 | 5C | 47 | 50 | 58 | 37 |
| 8                 | 5C                   | 18 | 5C | 5C | 5C | 5C | 5C | 5C | 68 | 71 | 79 | 5C | 48 | 51 | 59 | 38 |
| 9                 | 5C                   | 19 | 5C | 5C | 5C | 5C | 5C | 60 | 69 | 72 | 7A | 5C | 49 | 52 | 5A | 39 |
| A                 | 5C                   | 5C | 5C | 5C | 5B | 5D | 7C | 3A | 5C |
| B                 | 0B                   | 5C | 5C | 5C | 2E | 24 | 2C | 23 | 5C |
| C                 | 0C                   | 1C | 5C | 14 | 3C | 2A | 25 | 40 | 5C |
| D                 | 0D                   | 1D | 05 | 15 | 28 | 29 | 5F | 27 | 5C |
| E                 | 0E                   | 1E | 06 | 5C | 2B | 3B | 3E | 3D | 5C |
| F                 | 0F                   | 1F | 07 | 1A | 21 | 5E | 3F | 22 | 5C | FF |

ZK-4249-GE

**EBCDIC to ASCII Translation Table**

- The numbers on the left represent the low-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers across the top represent the high-order bits of the EBCDIC characters in hexadecimal notation.
- The numbers in the body of the table represent the equivalent ASCII characters in hexadecimal notation.

All EBCDIC graphics are translated to their equivalent ASCII graphic except for the graphics noted in Table LIB-14.

**Table LIB-14 EBCDIC Graphics Not Translated to ASCII Equivalent by LIB\$TRA\_EBC\_ASC**

| EBCDIC Graphic        | ASCII Graphic            |
|-----------------------|--------------------------|
| ¢ (cents sign)        | [ (left square bracket)  |
| (short vertical bar)  | ! (exclamation point)    |
| ¬ (logical not)       | ^ (circumflex)           |
| ! (exclamation point) | ] (right square bracket) |

**LIB\$ Routines**  
**LIB\$TRA\_EBC\_ASC**

**Condition Values Returned**

**SS\$\_NORMAL**

Routine successfully completed.

**LIB\$\_INVCHA**

One or more occurrences of an untranslatable character have been detected during the translation.

**LIB\$\_INVARG**

If the destination string is a fixed-length string and its length is not the same as the source string length, or if the length of the input string is greater than 65,535 characters, no translation is attempted.

---

## LIB\$TRIM\_FILESPEC

### Fit Long File Specification into Fixed Field

The Fit Long File Specification into Fixed Field routine takes a file specification, such as an RMS resultant name string, and shortens it (if necessary) so that it fits into a field of fixed width.

#### Format

LIB\$TRIM\_FILESPEC old-filespec ,new-filespec [,word-integer-width] [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### old-filespec

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

File specification to be trimmed. The **old-filespec** argument contains the address of a descriptor pointing to this file specification string.

The file specification should be an RMS resultant name string. The error LIB\$\_INVARG is returned if **old-filespec** contains more than 255 characters.

##### new-filespec

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Trimmed file specification. The **new-filespec** argument contains the address of a descriptor pointing to this trimmed file specification string. LIB\$TRIM\_FILESPEC writes the trimmed file specification into **new-filespec**.

##### word-integer-width

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Maximum field width desired. The **word-integer-width** argument is the address of an unsigned word that contains this maximum field width.

If omitted, the current length of **new-filespec** is used. If **new-filespec** is not a fixed-length string, you should specify **word-integer-width** to ensure that the desired width is used.

## LIB\$ Routines

### LIB\$TRIM\_FILESPEC

#### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the trimmed file specification, not including any blank padding or truncated characters. The **resultant-length** argument is the address of an unsigned word that contains this length. This is an optional argument.

## Description

This routine trims file specifications in a consistent, predictable manner to fit in a fixed-length field using the same algorithm that Digital software uses.

LIB\$TRIM\_FILESPEC allows compilers and other utilities which need to display file specifications in fixed-length fields, such as listing headers, to display file specifications in a consistent fashion.

If necessary to make the file specification fit into the specified field width, LIB\$TRIM\_FILESPEC removes portions of the file specification in this order:

1. Node (including access control)
2. Device
3. Directory
4. Version
5. Type

If, after removing all these fields, the file name is still longer than the field width, the file name is truncated and the alternate success status LIB\$\_STRTRU is returned.

LIB\$TRIM\_FILESPEC supports any string class for the **old-filespec** and **new-filespec** string arguments.

## Condition Values Returned

|                 |  |
|-----------------|--|
| SS\$_NORMAL     | Routine successfully completed.  |
| LIB\$_STRTRU    | Success, but the output string was truncated. Significant characters of the trimmed file specification were truncated. |
| LIB\$_INVARG    | Invalid argument. The <b>old-filespec</b> argument contained more than 255 characters.                                 |
| LIB\$_INVSTRDES | Invalid string descriptor.   |
| LIB\$_WRONUMARG | Wrong number of arguments.   |

Any condition values returned by LIB\$SCOPY\_R\_DX.

Any condition values returned by the \$FILESCAN system service.

Example

```

PROGRAM TRIM_FILESPEC(INPUT,OUTPUT);

{+}
{ This PASCAL example program demonstrates the
{ use of LIB$TRIM_FILESPEC.
{-}

    TYPE
        WORD = [WORD] 0..65535;

    VAR
        INPUT_FILESPEC : VARYING [255] OF CHAR;
        OUTPUT_FILESPEC : VARYING [32] OF CHAR;
        RETURNED_STATUS : INTEGER;

    [EXTERNAL] FUNCTION LIB$TRIM_FILESPEC(
        IN_FILE      : VARYING [LEN1] OF CHAR;
        VAR OUT_FILE : VARYING [LEN2] OF CHAR;
        WIDTH        : WORD := %IMMED 0;
        OUT_LEN      : [REFERENCE] WORD := %IMMED 0
    ) : INTEGER; EXTERNAL;

    [EXTERNAL] FUNCTION LIB$STOP(
        CONDITION_STATUS : [IMMEDIATE,UNSAFE] UNSIGNED;
        FAO_ARGS         : [IMMEDIATE,UNSAFE,LIST] UNSIGNED
    ) : INTEGER; EXTERNAL;

BEGIN

{+}
{ Start with a large INPUT_FILESPEC.
{-}
    INPUT_FILESPEC := 'DISK$NAME:[DIRECTORY1.DIRECTORY2]FILENAME.EXTENSION;1';

{+}
{ Use LIB$TRIM_FILESPEC to shorten it to fit a smaller variable.
{-}
    RETURNED_STATUS := LIB$TRIM_FILESPEC(
        INPUT_FILESPEC,
        OUTPUT_FILESPEC,
        SIZE(OUTPUT_FILESPEC.BODY));
    IF NOT ODD(RETURNED_STATUS)
    THEN
        LIB$STOP(RETURNED_STATUS);

{+}
{ Print out the original file name along with the
{ shortened file name.
{-}
    WRITELN('Original file specification ',INPUT_FILESPEC);
    WRITELN('Shortened file specification ',OUTPUT_FILESPEC);

END.

```

This PASCAL example program demonstrates the use of LIB\$TRIM\_FILESPEC.  
The output generated by this program is as follows:

```

Original file specification DISK$NAME:[DIRECTORY1.DIRECTORY2]FILENAME.EXTENSION;1
Shortened file specification FILENAME.EXTENSION;1

```

## LIB\$TRIM\_FULLNAME

### Trim a Full Name to Fit into a Desired Output Field

The Trim a Full Name to Fit into a Desired Output Field routine trims a full name to fit into a desired output field. The trimming preserves the most significant part of the full name.†

#### Format

LIB\$TRIM\_FULLNAME fullname, trimmed-nodename [,output-width] [,resultant-length]

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Arguments

##### fullname

OpenVMS usage: char\_string  
type: character string  
access: read only  
mechanism: by descriptor

Full name to be trimmed. The **fullname** argument contains the address of a descriptor pointing to this full name string.

The error LIB\$\_INVARG is returned if **fullname** contains an invalid full name, points to a null string, or contains more than 1024 characters. The error LIB\$\_INVSTRDES is returned if **fullname** is an invalid descriptor.

##### trimmed-nodename

OpenVMS usage: char\_string  
type: character string  
access: write only  
mechanism: by descriptor

Trimmed node name. The **trimmed-nodename** argument contains the address of a descriptor pointing to the trimmed node-name string. LIB\$TRIM\_FULLNAME writes the trimmed node name into the buffer pointed to by **trimmed-nodename**.

The error LIB\$\_INVSTRDES is returned if **trimmed-nodename** is an invalid descriptor.

The length field of the **trimmed-nodename** descriptor is not updated unless **trimmed-nodename** is a dynamic descriptor with a length less than the resultant trimmed node name. Refer to the *OpenVMS RTL String Manipulation (STR\$) Manual* for dynamic string descriptor usage.

The **trimmed-nodename** argument contains an unusable result when LIB\$TRIM\_FULLNAME returns in error.

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

### output-width

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: read only  
mechanism: by reference

Field width desired for the trimmed node name. The **output-width** argument is the address of an unsigned word that contains this field width in bytes.

If **output-width** is omitted, the current length of **trimmed-nodename** is used. If **trimmed-nodename** is not a fixed-length string, specify **output-width** to ensure that the desired width is used.

If the lengths of both **trimmed-nodename** and **output-width** are specified, the length in **output-width** is used. In this case, if the current length of **trimmed-nodename** is smaller than the length of **output-width**, the output trimmed node name is truncated at the end, and the alternate successful status LIB\$\_STRTRU is returned.

### resultant-length

OpenVMS usage: word\_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the trimmed node name. The **resultant-length** argument is the address of an unsigned word that contains this length in bytes.

The **resultant-length** argument contains an unusable result when LIB\$TRIM\_FULLNAME returns in error.

## Description

This routine trims a full name to the length that fits the desired output field. It allows applications to trim long full names for displaying in a fixed-length field, such as listing headers, in a consistent manner.

Full names are validated. Valid full names are defined as full names expanded from using LIB\$EXPAND\_NODENAME. A node name must be expanded to a full name using LIB\$EXPAND\_NODENAME before calling LIB\$TRIM\_FULLNAME. The error LIB\$\_INVARG is returned if the input full name is invalid.

If the length of **fullname** is less than or equal to the desired output width, no trimming is performed, and **fullname** is returned in **trimmed-nodename**. Trailing blanks are padded if necessary.

Trimming is performed when the length of **fullname** is larger than the desired output width. The alternate successful status LIB\$\_STRTRU is returned.

The trimmed node name contains the significant part of the full name. This allows the most important information of a full name to be retained for display purposes. The significant part of a full name is determined by the underlying network services.

On a DECnet Phase IV system, trimming a DECnet/OSI full name results in the error condition LIB\$\_INVARG.

## LIB\$ Routines

### LIB\$TRIM\_FULLNAME

If a usable short form of a node name is desired for display purposes, call LIB\$COMPRESS\_NODENAME first. If LIB\$COMPRESS\_NODENAME returns LIB\$\_STRTRU, LIB\$TRIM\_FULLNAME can then be used to return the trimmed node name.

LIB\$TRIM\_FULLNAME adds padding spaces to the end of the output buffer if the trimmed node name is shorter than the size of the output buffer. The argument **resultant-length**, if supplied, is set to the length of the trimmed node name, excluding any padding spaces.

### Condition Values Returned

|   |  |
|---|--|
| SS\$_NORMAL   | Routine successfully completed.  |
| LIB\$_STRTRU  | Routine successfully completed. Characters are truncated in the output buffer pointed to by <b>trimmed-nodename</b> .  |
| LIB\$_INVARG  | Invalid argument: <ul style="list-style-type: none"> <li>• <b>fullname</b> is invalid.</li> <li>• <b>fullname</b> points to a null string.</li> <li>• The length of the input full name is more than 1024 characters.</li> <li>• The trimmed DECnet/OSI node name is invalid in a DECnet Phase IV system.</li> </ul> |
| LIB\$_INVSTRDES   | Invalid string descriptor.   |
| LIB\$_WRONUMARG   | Wrong number of arguments.   |
| Any condition value returned by LIB\$SCOPY_R_DX.          |  |
| Any condition value returned by the \$IPC DECnet service. |  |

### Examples

The following table gives some examples of the results of using LIB\$TRIM\_FULLNAME:

| Full Name     | Size of Output Field | Trimmed Node Name |
|---------------|----------------------|-------------------|
| NODE          | 3                    | NOD               |
| NODE          | 8                    | NODE              |
| DEC:.FOO.NODE | 5                    | .NODE             |
| DEC:.FOO.NODE | 8                    | FOO.NODE          |
| DEC:.FOO.NODE | 20                   | DEC:.FOO.NODE     |

---

## LIB\$VERIFY\_VM\_ZONE

### Verify a Zone

The Verify a Zone routine performs verification of a 32-bit zone.†

#### Format

LIB\$VERIFY\_VM\_ZONE zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**zone-id**  
OpenVMS usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier of the zone to be verified. The **zone-id** argument is the address of an unsigned longword that contains this zone identifier. A value of 0 indicates the 32-bit default zone.

#### Description

LIB\$VERIFY\_VM\_ZONE verifies a zone. LIB\$VERIFY\_VM\_ZONE performs verification of the zone header and scans all of the queues and lists maintained in the zone header; this includes the lookaside lists and the free lists. If the zone was created with LIB\$M\_VM\_FREE\_FILL0 or LIB\$M\_VM\_FREE\_FILL1, LIB\$VERIFY\_VM\_ZONE also checks the contents of the free blocks.

As soon as an error is encountered, processing stops. If LIB\$\_BADZONE is returned, use the routine LIB\$SHOW\_VM\_ZONE to dump the zone information.

You must have exclusive access to the zone while the verification is proceeding. Results are unpredictable if another thread of control modifies the zone while this routine is analyzing control data or scanning control blocks.

#### Condition Values Returned

|                 |                                 |
|-----------------|---------------------------------|
| SS\$_NORMAL     | Routine successfully completed. |
| LIB\$_BADZONE   | Invalid zone.                   |
| LIB\$_INVARG    | Invalid or null argument.       |
| LIB\$_WRONUMARG | Wrong number of arguments.      |

---

† No support for arguments passed by 64-bit address reference or for use of 64-bit descriptors, if applicable, is planned for this routine.

## LIB\$ Routines

### LIB\$VERIFY\_VM\_ZONE\_64 (Alpha Only)

---

## LIB\$VERIFY\_VM\_ZONE\_64 (Alpha Only)

### Verify a Zone

The Verify a Zone routine performs verification of a 64-bit zone.

#### Format

LIB\$VERIFY\_VM\_ZONE\_64 zone-id

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**zone-id**  
OpenVMS usage: identifier  
type: quadword (unsigned)  
access: read only  
mechanism: by reference

Zone identifier of the zone to be verified. The **zone-id** argument is the address of an unsigned quadword that contains this zone identifier. A value of 0 indicates the 64-bit default zone.

#### Description

LIB\$VERIFY\_VM\_ZONE\_64 verifies a zone. LIB\$VERIFY\_VM\_ZONE\_64 performs verification of the zone header and scans all of the queues and lists maintained in the zone header; this includes the lookaside lists and the free lists. If the zone was created with the LIB\$M\_VM\_FREE\_FILL0 or LIB\$M\_VM\_FREE\_FILL1 algorithm, LIB\$VERIFY\_VM\_ZONE\_64 also checks the contents of the free blocks.

As soon as an error is encountered, processing stops. If LIB\$\_BADZONE is returned, use the routine LIB\$SHOW\_VM\_ZONE\_64 to dump the zone information.

You must have exclusive access to the zone while the verification is proceeding. Results are unpredictable if another thread of control modifies the zone while this routine is analyzing control data or scanning control blocks.

#### Condition Values Returned

|                 |                                 |
|-----------------|---------------------------------|
| SS\$_NORMAL     | Routine successfully completed. |
| LIB\$_BADZONE   | Invalid zone.                   |
| LIB\$_INVARG    | Invalid or null argument.       |
| LIB\$_WRONUMARG | Wrong number of arguments.      |

---

## LIB\$WAIT

### Wait a Specified Period of Time

The Wait a Specified Period of Time routine places the current process into hibernation for the number of seconds specified in its argument.

#### Format

LIB\$WAIT seconds

#### Returns

OpenVMS usage: cond\_value  
type: longword (unsigned)  
access: write only  
mechanism: by value

#### Argument

**seconds**  
OpenVMS usage: floating\_point  
type: F\_floating  
access: read only  
mechanism: by reference

The number of seconds to wait. The **seconds** argument contains the address of an F-floating number that is this number.

The value is rounded to the nearest hundredth-second before use. Seconds must be between 0.0 and 100,000.0.

#### Description

LIB\$WAIT rounds the value specified by seconds to the nearest hundredth-second, uses the \$SCHDWK system service to schedule a wakeup for that interval, and then issues the \$HIBER system service to hibernate until the wakeup occurs.

Because of other system activity, the length of time that the process actually waits may be somewhat longer than what was specified by **seconds**.

The process hibernates in the caller's access mode; therefore, asynchronous system traps (ASTs) may be delivered while the process is hibernating. However, if the process hibernates at AST level, further ASTs can not be delivered. See the *OpenVMS System Services Reference Manual* for more information.

#### Condition Values Returned

|                 |   |
|-----------------|---|
| SS\$_NORMAL     | Routine successfully completed.   |
| LIB\$_INVARG    | Invalid argument. The value of <b>seconds</b> was less than 0 or greater than 100,000.0 |
| LIB\$_WRONUMARG | Wrong number of arguments. An incorrect number of arguments was passed to LIB\$WAIT.    |

Any condition values returned by the \$SCHDWK system service.

## LIB\$ Routines

### LIB\$WAIT

#### Example

```
IDENTIFICATION DIVISION.  
PROGRAM-ID. SAMPLE.  
DATA DIVISION.  
WORKING-STORAGE SECTION.  
01    DELAY COMP-1.  
ROUTINE DIVISION.  
START-SAMPLE.  
    MOVE 3.5 TO DELAY.  
    CALL "LIB$WAIT"  
    USING BY REFERENCE DELAY.  
    STOP RUN.
```

This COBOL program demonstrates the use of LIB\$WAIT. When run, it waits for 3.5 seconds and then exits.

---

## **CVT\$ Reference Section**

This section provides a detailed discussion of the routines provided by the OpenVMS RTL (CVT\$) Facility.



## CVT\$CONVERT\_FLOAT

### Convert Floating-Point Data Type

The CVT\$CONVERT\_FLOAT routine provides a simplified options-interface for converting a floating-point data type to another supported floating-point data type.

#### Format

CVT\$CONVERT\_FLOAT input\_value, input\_type\_code, output\_value, output\_type\_code, options

#### Returns

OpenVMS usage: cond\_value  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

#### Argument

##### input\_value

OpenVMS usage: varying\_arg  
 type: unspecified  
 access: read only  
 mechanism: by reference

The address of a data area containing a floating-point number that is to be converted. The **input\_value** argument may contain floating-point data in F\_Floating, D\_Floating, G\_Floating, H\_Floating, IEEE\_S\_Floating, IEEE\_T\_Floating, IEEE\_X\_Floating, IBM\_Long\_Floating, IBM\_Short\_Floating, or Cray\_Floating format. The value of the **input\_type\_code** argument determines the format and size of the **input\_value** argument.

##### input\_type\_code

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: read only  
 mechanism: by value

The value of a longword bit mask specifying the type of floating-point data being passed in the **input\_value** argument. Valid type codes are:

| input_type_code | Format          | Size in Bytes |
|-----------------|-----------------|---------------|
| CVT\$K_VAX_F    | F_Floating      | 4             |
| CVT\$K_VAX_D    | D_Floating      | 8             |
| CVT\$K_VAX_G    | G_Floating      | 8             |
| CVT\$K_VAX_H    | H_Floating      | 16            |
| CVT\$K_IEEE_S   | IEEE_S_Floating | 4             |
| CVT\$K_IEEE_T   | IEEE_T_Floating | 8             |
| CVT\$K_IEEE_X   | IEEE_X_Floating | 16            |

## CVT\$ Routine CVT\$CONVERT\_FLOAT

| input_type_code  | Format             | Size in Bytes |
|------------------|--------------------|---------------|
| CVT\$K_IBM_LONG  | IBM_Long_Floating  | 8             |
| CVT\$K_IBM_SHORT | IBM_Short_Floating | 4             |
| CVT\$K_CRAY      | Cray_Floating      | 8             |

Declarations for the **input\_type\_code** argument are in the \$CVTDEF module found in the system symbol libraries.

### output\_value

OpenVMS usage: varying\_arg  
 type: unspecified  
 access: write only  
 mechanism: by reference

The address of a data area that receives the converted floating-point number. The **output\_value** argument can contain floating-point data in F\_Floating, D\_Floating, G\_Floating, H\_Floating, IEEE\_S\_Floating, IEEE\_T\_Floating, IEEE\_X\_Floating, IBM\_Long\_Floating, IBM\_Short\_Floating, or Cray\_Floating format. The value of the **output\_type\_code** argument determines the size and format of the data placed into the **output\_value** argument.

### output\_type\_code

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: read only  
 mechanism: by value

The value of a longword bit mask specifying the type of floating-point data that the **input\_value** argument will be converted into and returned in the **output\_value** argument. Valid type codes are:

| output_type_code | Format             | Size in Bytes |
|------------------|--------------------|---------------|
| CVT\$K_VAX_F     | F_Floating         | 4             |
| CVT\$K_VAX_D     | D_Floating         | 8             |
| CVT\$K_VAX_G     | G_Floating         | 8             |
| CVT\$K_VAX_H     | H_Floating         | 16            |
| CVT\$K_IEEE_S    | IEEE_S_Floating    | 4             |
| CVT\$K_IEEE_T    | IEEE_T_Floating    | 8             |
| CVT\$K_IEEE_X    | IEEE_X_Floating    | 16            |
| CVT\$K_IBM_LONG  | IBM_Long_Floating  | 8             |
| CVT\$K_IBM_SHORT | IBM_Short_Floating | 4             |
| CVT\$K_CRAY      | Cray_Floating      | 8             |

Declarations for the **output\_type\_code** argument are in the \$CVTDEF module found in the system symbol libraries.

**options**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by value

Conversion option specifier. The **options** argument is the address of a longword bit mask in which each option bit set causes the corresponding option to be used during the conversion.

The following options can be specified using the **options** argument:

| Option                  | Description  |
|-------------------------|--|
| CVT\$M_ROUND_TO_NEAREST | The default rounding option for conversions to IEEE data types. This IEEE Std. 754 rounding mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the one whose least significant bit is 0 is the result.   |
| CVT\$M_VAX_ROUNDING     | The default rounding option for conversions to non-IEEE data types. Performs "traditional" style rounding. This mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the output value is the closest to either positive infinity or negative infinity, depending on the sign of the input value. |
| CVT\$M_TRUNCATE         | Round the output value toward zero (truncate).   |
| CVT\$M_ROUND_TO_POS     | Round the output value toward positive infinity.   |
| CVT\$M_ROUND_TO_NEG     | Round the output value toward negative infinity.   |
| CVT\$M_BIG_ENDIAN       | Interprets IEEE data types as Big Endian.  |
| CVT\$M_ERR_UNDERFLOW    | Report underflow conditions as errors.   |

Declarations for the options argument are in the \$CVTDEF module found in the system symbol libraries.

**Description**

CVT\$CONVERT\_FLOAT is a general purpose floating-point conversion routine that converts any **input\_type\_code** floating-point data type into any **output\_type\_code** floating-point data type. The conversion is subject to the options specified in the **options** argument.

**Note**

OpenVMS compilers do not support arithmetic operations for all of the above floating-point data types. Additional floating-point data types are supported by this routine for data conversion purposes only.

# CVT\$ Routine

## CVT\$CONVERT\_FLOAT

### Condition Values Returned

|                 |   |
|-----------------|---|
| CVT\$_NORMAL    | Normal successful completion.             |
| CVT\$_INPCONERR | Input conversion error.                   |
| CVT\$_INVINTYP  | Invalid input type code.                  |
| CVT\$_INVOPT    | Invalid option argument.                  |
| CVT\$_INVOUTTYP | Invalid output type code.                 |
| CVT\$_INVVAL    | Input value was an invalid number or NaN. |
| CVT\$_NEGINF    | Input value was negative infinity.        |
| CVT\$_OUTCONERR | Output conversion error.                  |
| CVT\$_OVERFLOW  | Overflow detected during conversion.      |
| CVT\$_POSINF    | Input value was positive infinity.        |
| CVT\$_UNDERFLOW | Underflow detected during conversion.     |

Return status values are in the \$CVTMSG module found in the system symbol libraries.

### Example

```
/*
** =====
**
** Example of CVT$CONVERT_FLOAT
**
** -----
**
** This example program reads IEEE T floating-point numbers from an
** input file, converts them to VAX D floating-point numbers and
** writes the result to an output file.
**
** The input and output file names can be specified as the first and
** second arguments on the command line as follows:
**
**     $ EXAMPLE IEEE_T_INPUT_FILE.DAT VAX_D_OUTPUT_FILE.DAT
**
** If the input or output files are not included on the command
** line then the program prompts the user for them.
** =====
*/
#include <stdio.h>

unsigned long CVT$CONVERT_FLOAT(void *input_value,
                                unsigned long input_type,
                                void *output_value,
                                unsigned long output_type,
                                unsigned long options);

globalvalue CVT$K_VAX_D;
globalvalue CVT$K_IEEE_T;
globalvalue CVT$M_ROUND_TO_NEAREST;
globalvalue CVT$_NORMAL;

main(int argc, char *argv[])
{
```

**CVT\$ Routine  
CVT\$CONVERT\_FLOAT**

```

double      D_Float_number;
unsigned long IEEE_Double_number[2];
unsigned long options;
char        in_filename[80];
char        out_filename[80];
FILE        *in_file, *out_file;
unsigned long ret_status;

/*
** Find out where we are going to get the data from.
** First look at the first argument of the command line.
** If nothing is there, then attempt to use IEEE_T_IN.DAT.
** =====
*/
if (argc == 1)
{
    printf("Enter input data file: [IEEE_T_IN.DAT]: ");
    if (gets(in_filename) == NULL)
        exit(1);

    if (strlen(in_filename) == 0)
        strcpy(in_filename, "IEEE_T_IN.DAT");
}
else
    strcpy(in_filename, argv[1]);

/*
** Find out where we are going to put the output data.
** First look at the second argument of the command line.
** If nothing is there, then put it in VAX_D_OUT.DAT
** =====
*/
if (argc <= 2)
{
    printf("Enter output data file: [VAX_D_OUT.DAT]: ");
    if (gets(out_filename) == NULL)
        exit(1);

    if (strlen(out_filename) == 0)
        strcpy(out_filename, "VAX_D_OUT.DAT");
}
else
    strcpy(out_filename, argv[2]);

/*
** Open the input and output files.
** =====
*/
if ((in_file = fopen(in_filename, "r")) == NULL)
{
    fprintf(stderr, "%s couldn't open file %s\n", argv[0], in_filename);
    exit(1);
}

out_file = fopen(out_filename, "wb");
options   = CVT$M_ROUND_TO_NEAREST;
ret_status = CVT$_NORMAL;

```

## CVT\$ Routine CVT\$CONVERT\_FLOAT

```
/*
** Read in each number from the file, convert it, and write it to
** the output file.
** =====
*/
while ((fread (&IEEE_Double_number[0],
              sizeof(IEEE_Double_number),
              1,
              in_file) == 1) &&
       (ret_status == CVT$NORMAL))
{
    ret_status = CVT$CONVERT_FLOAT(&IEEE_Double_number[0], CVT$K_IEEE_T,
                                   &D_Float_number, CVT$K_VAX_D,
                                   options);

    if (ret_status == CVT$NORMAL)
    {
        fwrite(&D_Float_number, sizeof(D_Float_number), 1, out_file);
        printf("Converted data: %lf.\n", D_Float_number);
    }
}
fclose(in_file);
fclose(out_file);

if (ret_status == CVT$NORMAL)
    exit(1);
else
    exit(ret_status);
}
```

## CVT\$FTOF Convert Floating-Point Data Type

The CVT\$FTOF routine converts floating-point data types to other supported floating-point data types and allows additional control over the converted results. CVT\$FTOF functionality is also available on other Digital-supported platforms.

### Format

status = CVT\$FTOF input\_value, input\_type\_code, output\_value, output\_type\_code, options

### Returns

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: write only  
 mechanism: by value

The **status** return value is an unsigned longword bit mask containing the condition codes raised by the function. CVT\$FTOF returns CVT\$K\_NORMAL; otherwise, it sets one or more recoverable and unrecoverable conditions. Use the following condition names to determine which conditions are set:

| Condition Name             | Condition (always reported by default) |
|----------------------------|--|
| CVT\$K_NORMAL              | Normal successful completion.          |
| CVT\$M_INVALID_INPUT_TYPE  | Invalid input type code.               |
| CVT\$M_INVALID_OUTPUT_TYPE | Invalid output type code.              |
| CVT\$M_INVALID_OPTION      | Invalid option argument.               |

| Condition Name                | Condition (reported only if the CVT\$M_REPORT_ALL option is selected)   |
|-------------------------------|---|
| CVT\$M_RESULT_INFINITE        | Conversion produced an infinite result. <sup>1</sup>  |
| CVT\$M_RESULT_DENORMALIZED    | Conversion produced a denormalized result. <sup>1</sup>   |
| CVT\$M_RESULT_OVERFLOW_RANGE  | Conversion yielded an exponent > 60000 (8). <sup>2</sup>  |
| CVT\$M_RESULT_UNDERFLOW_RANGE | Conversion yielded an exponent < 20000 (8). <sup>2</sup>  |
| CVT\$M_RESULT_UNNORMALIZED    | Conversion produced an unnormalized result. <sup>3</sup>  |
| CVT\$M_RESULT_INVALID         | Conversion result is either ROP (reserved operand), NaN (not a number), or closest equivalent. CRAY and IBM data types return 0. <sup>4</sup> |
| CVT\$M_RESULT_OVERFLOW        | Conversion resulted in overflow. <sup>4</sup>   |
| CVT\$M_RESULT_UNDERFLOW       | Conversion resulted in underflow. <sup>4</sup>  |
| CVT\$M_RESULT_INEXACT         | Conversion resulted in a loss of precision. <sup>4</sup>  |

<sup>1</sup>For IEEE data type conversions.

<sup>2</sup>For CRAY data type conversions.

<sup>3</sup>For IBM data type conversions.

<sup>4</sup>For all data type conversions.

Return status values are in the \$CVTDEF module found in the system symbol libraries.

# CVT\$ Routine CVT\$FTOF

## Arguments

### input\_value

OpenVMS usage: `varying_arg`  
type: `unspecified`  
access: `read only`  
mechanism: `by reference`

The address of a data area containing a floating-point number to be converted. The **input\_value** argument can contain floating-point data in one of the following formats:

|                 |                            |
|-----------------|----------------------------|
| F_Floating      | Big_Endian_IEEE_S_Floating |
| D_Floating      | Big_Endian_IEEE_T_Floating |
| G_Floating      | Big_Endian_IEEE_X_Floating |
| H_Floating      | IBM_Long_Floating          |
| IEEE_S_Floating | IBM_Short_Floating         |
| IEEE_T_Floating | CRAY_Floating_Single       |
| IEEE_X_Floating |                            |

The value of the **input\_type\_code** argument determines the format and size of the **input\_value** argument.

### input\_type\_code

OpenVMS usage: `longword_unsigned`  
type: `longword (unsigned)`  
access: `read only`  
mechanism: `by value`

The value of a longword bit mask specifying the type of floating-point data being passed in the **input\_value** argument. Valid type codes are:

| input_type_code          | Format                     | Size in Bytes |
|--------------------------|----------------------------|---------------|
| CVT\$K_VAX_F             | F_Floating                 | 4             |
| CVT\$K_VAX_D             | D_Floating                 | 8             |
| CVT\$K_VAX_G             | G_Floating                 | 8             |
| CVT\$K_VAX_H             | H_Floating                 | 16            |
| CVT\$K_IEEE_S            | IEEE_S_Floating            | 4             |
| CVT\$K_IEEE_T            | IEEE_T_Floating            | 8             |
| CVT\$K_IEEE_X            | IEEE_X_Floating            | 16            |
| CVT\$K_BIG_ENDIAN_IEEE_S | Big_Endian_IEEE_S_Floating | 4             |
| CVT\$K_BIG_ENDIAN_IEEE_T | Big_Endian_IEEE_T_Floating | 8             |
| CVT\$K_BIG_ENDIAN_IEEE_X | Big_Endian_IEEE_X_Floating | 16            |
| CVT\$K_IBM_LONG          | IBM_Long_Floating          | 8             |
| CVT\$K_IBM_SHORT         | IBM_Short_Floating         | 4             |
| CVT\$K_CRAY_SINGLE       | CRAY_Floating              | 8             |

Declarations for the **input\_type\_code** argument are in the `$CVTDEF` module found in the system symbol libraries.

**output\_value**

OpenVMS usage: varying\_arg  
 type: unspecified  
 access: write only  
 mechanism: by reference

The address of a data area that receives the converted floating-point number. The **output\_value** argument can contain floating-point data in F\_Floating, D\_Floating, G\_Floating, H\_Floating, IEEE\_S\_Floating, IEEE\_T\_Floating, IEEE\_X\_Floating, Big\_Endian\_IEEE\_S\_Floating, Big\_Endian\_IEEE\_T\_Floating, Big\_Endian\_IEEE\_X\_Floating, IBM\_Long\_Floating, IBM\_Short\_Floating, or CRAY\_Floating\_Single format. The value of the **output\_type\_code** argument determines the size and format of the data placed into the **output\_value** argument.

**output\_type\_code**

OpenVMS usage: longword\_unsigned  
 type: longword (unsigned)  
 access: read only  
 mechanism: by value

The value of a longword bit mask specifying the type of floating-point data that the **input\_value** argument will be converted into and returned in the **output\_value** argument. Valid type codes are:

| output_type_code         | Format                     | Size in Bytes |
|--------------------------|----------------------------|---------------|
| CVT\$K_VAX_F             | F_Floating                 | 4             |
| CVT\$K_VAX_D             | D_Floating                 | 8             |
| CVT\$K_VAX_G             | G_Floating                 | 8             |
| CVT\$K_VAX_H             | H_Floating                 | 16            |
| CVT\$K_IEEE_S            | IEEE_S_Floating            | 4             |
| CVT\$K_IEEE_T            | IEEE_T_Floating            | 8             |
| CVT\$K_IEEE_X            | IEEE_X_Floating            | 16            |
| CVT\$K_BIG_ENDIAN_IEEE_S | Big_Endian_IEEE_S_Floating | 4             |
| CVT\$K_BIG_ENDIAN_IEEE_T | Big_Endian_IEEE_T_Floating | 8             |
| CVT\$K_BIG_ENDIAN_IEEE_X | Big_Endian_IEEE_X_Floating | 16            |
| CVT\$K_IBM_LONG          | IBM_Long_Floating          | 8             |
| CVT\$K_IBM_SHORT         | IBM_Short_Floating         | 4             |
| CVT\$K_CRAY_SINGLE       | CRAY_Floating              | 8             |

Declarations for the **output\_type\_code** argument are in the \$CVTDEF module found in the system symbol libraries.

**options**

OpenVMS usage: mask\_longword  
 type: longword (unsigned)  
 access: read only  
 mechanism: by value

Conversion option specifier. The **options** argument is the address of a longword bit mask in which each option bit set causes the corresponding option to be used during the conversion. Provide a zero (0) value to the **options** argument to

## CVT\$ Routine CVT\$FTOF

select default behavior or choose one or more options (status condition option, rounding options, "FORCE" options, CRAY and IBM options) from the following tables. Specify only the options that apply to your conversion. A conflicting or incompatible **options** argument is reported as an error (CVT\$M\_INVALID\_OPTION).

| Applicable Conversion | Status Condition Option | Description   |
|-----------------------|-------------------------|---|
| All                   | CVT\$M_REPORT_ALL       | Report all applicable status conditions as the default. The reporting of recoverable status conditions is disabled by default when this option is not used. |

| Applicable Conversion | Rounding Options        | Description   |
|-----------------------|-------------------------|---|
| All                   | CVT\$M_ROUND_TO_NEAREST | The default rounding option for conversions to IEEE data types. This IEEE Std. 754 rounding mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the one whose least significant bit is 0 is the result.  |
| All                   | CVT\$M_BIASED_ROUNDING  | The default rounding option for conversions to non-IEEE data types. Performs "traditional" style rounding. This mode results in the representable output value nearest to the infinitely precise result. If the two nearest representable values are equally near, the output value is the closest to either positive infinity or negative infinity depending on the sign of the input value. |
| All                   | CVT\$M_ROUND_TO_ZERO    | Round the output value toward zero (truncate).  |
| All                   | CVT\$M_ROUND_TO_POS     | Round the output value toward positive infinity.  |
| All                   | CVT\$M_ROUND_TO_NEG     | Round the output value toward negative infinity.  |

| Applicable Conversion | "FORCE" Options                            | Description  |
|-----------------------|--|--|
| All                   | CVT\$M_FORCE_ALL_SPECIAL_VALUES            | Apply all applicable "FORCE" options for the current conversion.   |
| IEEE                  | CVT\$M_FORCE_DENORM_TO_ZERO <sup>1</sup>   | Force a denormalized IEEE output value to zero.  |
| IEEE                  | CVT\$M_FORCE_INF_TO_MAX_FLOAT <sup>1</sup> | Force a positive IEEE infinite output value to +max_float and force a negative IEEE infinite output value to -max_float. |

<sup>1</sup>This option is valid only for conversions to IEEE output values.

## CVT\$ Routine CVT\$FTOF

| Applicable Conversion | "FORCE" Options                           | Description   |
|-----------------------|---|---|
| IEEE or VAX           | CVT\$M_FORCE_INVALID_TO_ZERO <sup>2</sup> | Force an invalid IEEE NaN (not a number) output value or a VAX ROP (reserved operand) output value to zero. |

<sup>2</sup>This option is valid only for conversions to IEEE or VAX output values.

| Applicable Conversion | Options for CRAY Format Conversion | Description                                       |
|-----------------------|------------------------------------|---|
| CRAY                  | CVT\$M_ALLOW_OVRFLW_RANGE_VALUES   | Allow an input/output exponent value > 60000 (8). |
| CRAY                  | CVT\$M_ALLOW_UDRFLW_RANGE_VALUES   | Allow an input/output exponent value < 20000 (8). |

| Applicable Conversion | Option for IBM Format Conversion | Description  |
|-----------------------|----------------------------------|--|
| IBM                   | CVT\$M_ALLOW_UNNORMALIZED_VALUES | Allow unnormalized input arguments. Allow an unnormalized output value for a small value that would normalize to zero. |

The maximum representable floating-point values (max\_float) for the IEEE\_S\_Floating, IEEE\_T\_Floating, IEEE\_X\_Floating, Big\_Endian\_IEEE\_S\_Floating, Big\_Endian\_IEEE\_T\_Floating, and Big\_Endian\_IEEE\_X\_Floating formats are:

| Data Type | Value for: max_float                                       |
|-----------|--|
| S         | Decimal: 3.402823e38                                       |
| T         | Decimal: 1.797693134862316e308                             |
| X         | Decimal: 1.189731495357231765085759326628007016196477e4932 |

Declarations for the options argument are in the \$CVTDEF module found in the system symbol libraries.

### Description

CVT\$FTOF functionality is available on all Digital platforms and is the floating-point conversion routine of choice for portability. When compared with the standard CVT\$CONVERT\_FLOAT routine, CVT\$FTOF includes additional functionality and increased performance.

## CVT\$ Routine CVT\$FTOF

CVT\$FTOF is a general-purpose floating-point conversion routine that converts any **input\_type\_code** floating-point data type into any **output\_type\_code** floating-point data type. The conversion is subject to the options specified in the **options** argument.

---

### Note

---

OpenVMS compilers do not support arithmetic operations for all of the floating-point data types described here. Additional floating-point data types are supported by this routine for data conversion purposes only.

---

---

# Index

## A

---

- Addition
  - quadword times, LIB-8
  - two's complement, LIB-5
- ASCII character set
  - EBCDIC translation from, LIB-358, LIB-588
  - EBCDIC translation to, LIB-360, LIB-592
- \$ASCTIM
  - RTL jacket routine, LIB-512
- ASTs (asynchronous system traps)
  - progress check, LIB-17

## B

---

- Binary numbers, multiple precision, LIB-5
- Binary subtraction, LIB-508
- Binary tree, balanced, LIB-299, LIB-308
- Bit fields
  - replace field, LIB-329
  - return sign extended to longword, LIB-170

## C

---

- CALLG (Call Routine with General Argument List) instruction, RTL routine to access, LIB-28, LIB-30
- Character sets
  - translation of, LIB-356
- Character string routines, LIB\$CHAR, LIB-31
- CLI symbols
  - deleting, LIB-138
  - getting value of, LIB-277
  - RTL routines, LIB-138, LIB-277, LIB-444
  - setting value of, LIB-444
- Condition handlers, establishing, LIB-164
- Condition values, LIB-349
- Conversion
  - of data type
    - descriptor to descriptor, LIB-84
- Conversions
  - general
    - descriptor to descriptor, LIB-84
- Conversions, numeric text to binary, LIB-97 to LIB-99

- Converting floating-point data types, CVT-3, CVT-9
  - CVT\$CONVERT\_FLOAT routine, CVT-3
  - CVT\$FTOF routine, CVT-9
- Cyclic redundancy check, LIB-42, LIB-44

## D

---

- Data types
  - conversion of
    - descriptor to descriptor, LIB-84
- Date/time routines
  - LIB\$DATE\_TIME, LIB-101
- Date/Time routines
  - LIB\$DAY, LIB-103
  - LIB\$DAY\_OF\_WEEK, LIB-105
- Decimal overflow detection, LIB-126
- Decimal text, converting to binary, LIB-97, LIB-99
- DECnet/OSI for OpenVMS
  - full name routines
    - LIB\$BUILD\_NODESPEC routine, LIB-25
    - LIB\$COMPARE\_NODENAME routine, LIB-33
    - LIB\$COMPRESS\_NODENAME routine, LIB-35
    - LIB\$EXPAND\_NODENAME routine, LIB-167
    - LIB\$FIT\_NODENAME routine, LIB-196
    - LIB\$GET\_FULLNAME\_OFFSET routine, LIB-260
    - LIB\$GET\_HOSTNAME routine, LIB-262
    - LIB\$TRIM\_FULLNAME routine, LIB-598
- Descriptors
  - analysis of, LIB-10
- Directories, creation of, LIB-46
- Division, extended precision, LIB-150
- Dynamic length strings
  - allocating, LIB-450 to LIB-452
  - deallocating, LIB-447, LIB-448

## E

---

- EBCDIC character set
  - ASCII translation from, LIB-360, LIB-592
  - ASCII translation to, LIB-358, LIB-588

EDIV (Extended Divide) instructions, RTL routine to access, LIB-150  
EMODD instructions, RTL routine to access, LIB-152  
EMODF instructions, RTL routine to access, LIB-154  
EMODG instructions, RTL routine to access, LIB-156  
EMODH instructions, RTL routine to access, LIB-158  
EMUL (Extended Multiply) instructions, RTL routine to access, LIB-160  
Event flags  
  reserve, LIB-423  
  RTL routine to free, LIB-210  
  status, LIB-254

## F

\$FAO system service  
  RTL jacket routine for, LIB-514  
Faults, fix floating reserved operands, LIB-199  
FFx instructions, RTL routine to access, LIB-175  
Floating-point number conversion  
  Big\_Endian\_IEEE\_S\_Floating, CVT-9  
  Big\_Endian\_IEEE\_T\_Floating, CVT-9  
  Big\_Endian\_IEEE\_X\_Floating, CVT-9  
  Cray\_Floating, CVT-9  
  D\_Floating, CVT-9  
  F\_Floating, CVT-9  
  G\_Floating, CVT-9  
  H\_Floating, CVT-9  
  IBM\_Long\_Floating, CVT-9  
  IBM\_Short\_Floating, CVT-9  
  IEEE\_S\_Floating, CVT-9  
  IEEE\_T\_Floating, CVT-9  
  IEEE\_X\_Floating, CVT-9  
Floating-point number conversions, CVT-3  
Floating-point underflow detection, LIB-201  
Full name routines  
  See DECnet/OSI full name routines

## H

Hexadecimal text, converting to binary, LIB-97, LIB-99  
Hibernation  
  LIB\$WAIT, LIB-603

## I

Integer overflow, LIB-331  
Invocation context  
  access routines, LIB-251, LIB-268, LIB-270, LIB-275, LIB-276, LIB-396  
  functions, LIB-251, LIB-268, LIB-270, LIB-275, LIB-276, LIB-396  
  obtaining handle, LIB-270

Invocation context (cont'd)  
  updating, LIB-396

## K

Keywords, in keyword table, LIB-337

## L

Language, user's choice of natural, LIB-280  
LIB\$ADAWI routine, LIB-3  
LIB\$ADDX routine, LIB-5  
LIB\$ADD\_TIMES routine, LIB-8  
LIB\$ANALYZE\_SDESC routine, LIB-10  
LIB\$ANALYZE\_SDESC\_64 routine, LIB-12  
LIB\$ASN\_WTH\_MBX routine, LIB-14  
LIB\$AST\_IN\_PROG routine, LIB-17  
LIB\$ATTACH routine, LIB-19  
LIB\$BBCCI routine, LIB-21  
LIB\$BBSSI routine, LIB-23  
LIB\$BUILD\_NODESPEC routine, LIB-25  
LIB\$CALLG routine, LIB-28  
LIB\$CALLG\_64 routine, LIB-30  
LIB\$CHAR routine, LIB-31  
LIB\$COMPARE\_NODENAME routine, LIB-33  
LIB\$COMPRESS\_NODENAME routine, LIB-35  
LIB\$CONVERT\_DATE\_STRING routine, LIB-38  
LIB\$CRC routine, LIB-42  
LIB\$CRC\_TABLE routine, LIB-44  
LIB\$CREATE\_DIR routine, LIB-46  
LIB\$CREATE\_USER\_VM\_ZONE routine, LIB-50  
LIB\$CREATE\_USER\_VM\_ZONE\_64 routine, LIB-54  
LIB\$CREATE\_VM\_ZONE routine, LIB-57  
LIB\$CREATE\_VM\_ZONE\_64 routine, LIB-63  
LIB\$CRF\_INS\_KEY routine, LIB-69  
LIB\$CRF\_INS\_REF routine, LIB-71  
LIB\$CRF\_OUTPUT routine, LIB-74  
LIB\$CURRENCY routine, LIB-78  
LIB\$CVTF\_FROM\_INTERNAL\_TIME routine, LIB-80  
LIB\$CVTF\_TO\_INTERNAL\_TIME routine, LIB-82  
LIB\$CVT\_DTB routine, LIB-97, LIB-99  
LIB\$CVT\_DX\_DX routine, LIB-84  
LIB\$CVT\_FROM\_INTERNAL\_TIME routine, LIB-90  
LIB\$CVT\_HTB routine, LIB-97, LIB-99  
LIB\$CVT\_OTB routine, LIB-97, LIB-99  
LIB\$CVT\_TO\_INTERNAL\_TIME routine, LIB-93  
LIB\$CVT\_VECTIM routine, LIB-95  
LIB\$DATE\_TIME routine, LIB-101  
LIB\$DAY routine, LIB-103  
LIB\$DAY\_OF\_WEEK routine, LIB-105  
LIB\$DECODE\_FAULT routine, LIB-107  
LIB\$DEC\_OVER routine, LIB-126

LIB\$DELETE\_FILE routine, LIB-128  
 LIB\$DELETE\_LOGICAL routine, LIB-136  
 LIB\$DELETE\_SYMBOL routine, LIB-138  
 LIB\$DELETE\_VM\_ZONE routine, LIB-140  
 LIB\$DELETE\_VM\_ZONE\_64 routine, LIB-142  
 LIB\$DIGIT\_SEP routine, LIB-144  
 LIB\$DISABLE\_CTRL routine, LIB-146  
 LIB\$DO\_COMMAND routine, LIB-148  
 LIB\$EDIV routine, LIB-150  
 LIB\$EMODD routine, LIB-152  
 LIB\$EMODF routine, LIB-154  
 LIB\$EMODG routine, LIB-156  
 LIB\$EMODH routine, LIB-158  
 LIB\$EMUL routine, LIB-160  
 LIB\$ENABLE\_CTRL routine, LIB-162  
 LIB\$ESTABLISH routine, LIB-164  
 LIB\$EXPAND\_NODENAME routine, LIB-167  
 LIB\$EXTV routine, LIB-170  
 LIB\$EXTZV routine, LIB-173  
 LIB\$FFC routine, LIB-175  
 LIB\$FFS routine, LIB-175  
 LIB\$FID\_TO\_NAME routine, LIB-177  
 LIB\$FILE\_SCAN routine, LIB-180  
 LIB\$FILE\_SCAN\_END routine, LIB-182  
 LIB\$FIND\_FILE routine, LIB-184  
 LIB\$FIND\_FILE\_END routine, LIB-188  
 LIB\$FIND\_IMAGE\_SYMBOL routine, LIB-189  
 LIB\$FIND\_VM\_ZONE routine, LIB-192  
 LIB\$FIND\_VM\_ZONE\_64 routine, LIB-194  
 LIB\$FIT\_NODENAME routine, LIB-196  
 LIB\$FIXUP\_FLT routine, LIB-199  
 LIB\$FLT\_UNDER routine, LIB-201  
 LIB\$FORMAT\_DATE\_TIME routine, LIB-203  
 LIB\$FORMAT\_SOGW\_PROT routine, LIB-206  
 LIB\$FREE\_DATE\_TIME\_CONTEXT routine,  
 LIB-209  
 LIB\$FREE\_EF routine, LIB-210  
 LIB\$FREE\_LUN routine, LIB-211  
 LIB\$FREE\_TIMER routine, LIB-212  
 LIB\$FREE\_VM routine, LIB-213  
 LIB\$FREE\_VM\_64 routine, LIB-216  
 LIB\$FREE\_VM\_PAGE routine, LIB-219  
 LIB\$FREE\_VM\_PAGE\_64 routine, LIB-221  
 LIB\$GETDVI routine, LIB-223  
 LIB\$GETJPI routine, LIB-228  
 LIB\$GETQUI routine, LIB-233  
 LIB\$GETSYI routine, LIB-238  
 LIB\$GET\_ACCNAM routine, LIB-242  
 LIB\$GET\_ACCNAM\_BY\_CONTEXT routine,  
 LIB-244  
 LIB\$GET\_COMMAND routine, LIB-246  
 LIB\$GET\_COMMON routine, LIB-249  
 LIB\$GET\_CURR\_INVO\_CONTEXT routine,  
 LIB-251  
 LIB\$GET\_DATE\_FORMAT routine, LIB-252  
 LIB\$GET\_EF routine, LIB-254  
 LIB\$GET\_FOREIGN routine, LIB-256  
 LIB\$GET\_FULLNAME\_OFFSET routine,  
 LIB-260  
 LIB\$GET\_HOSTNAME routine, LIB-262  
 LIB\$GET\_INPUT routine, LIB-265  
 LIB\$GET\_INVO\_CONTEXT routine, LIB-268  
 LIB\$GET\_INVO\_HANDLE routine, LIB-270  
 LIB\$GET\_LUN routine, LIB-271  
 LIB\$GET\_MAXIMUM\_DATE\_LENGTH routine,  
 LIB-273  
 LIB\$GET\_PREV\_INVO\_CONTEXT routine,  
 LIB-275  
 LIB\$GET\_PREV\_INVO\_HANDLE routine,  
 LIB-276  
 LIB\$GET\_SYMBOL routine, LIB-277  
 LIB\$GET\_USERS\_LANGUAGE routine, LIB-280  
 LIB\$GET\_VM routine, LIB-281  
 LIB\$GET\_VM\_64 routine, LIB-283  
 LIB\$GET\_VM\_PAGE routine, LIB-285  
 LIB\$GET\_VM\_PAGE\_64 routine, LIB-287  
 LIB\$ICHAR routine, LIB-289  
 LIB\$INDEX routine, LIB-291  
 LIB\$INIT\_DATE\_TIME\_CONTEXT routine,  
 LIB-293  
 LIB\$INIT\_TIMER routine, LIB-297  
 LIB\$INSERT\_TREE routine, LIB-299  
 LIB\$INSERT\_TREE\_64 routine, LIB-308  
 LIB\$INSQHI routine, LIB-317  
 LIB\$INSQHIQ routine, LIB-320  
 LIB\$INSQTI routine, LIB-323  
 LIB\$INSQTIQ routine, LIB-326  
 LIB\$INSV routine, LIB-329  
 LIB\$INT\_OVER routine, LIB-331  
 LIB\$LEN routine, LIB-333  
 LIB\$LOCC routine, LIB-334  
 LIB\$LOOKUP\_KEY routine, LIB-337  
 LIB\$LOOKUP\_TREE routine, LIB-341  
 LIB\$LOOKUP\_TREE\_64 routine, LIB-343  
 LIB\$LP\_LINES routine, LIB-345  
 LIB\$MATCHC routine, LIB-347  
 LIB\$MATCH\_COND routine, LIB-349  
 LIB\$MOVC3 routine, LIB-352  
 LIB\$MOVC5 routine, LIB-354  
 LIB\$MOVTC routine, LIB-356  
 LIB\$MOVTUC routine, LIB-373  
 LIB\$MULTF\_DELTA\_TIME routine, LIB-376  
 LIB\$MULT\_DELTA\_TIME routine, LIB-377  
 LIB\$PARSE\_ACCESS\_CODE routine, LIB-378  
 LIB\$PARSE\_SOGW\_PROT routine, LIB-381  
 LIB\$PAUSE routine, LIB-384  
 LIB\$POLYD routine, LIB-385  
 LIB\$POLYF routine, LIB-387  
 LIB\$POLYG routine, LIB-390  
 LIB\$POLYH routine, LIB-392  
 LIB\$PUT\_COMMON routine, LIB-394  
 LIB\$PUT\_INVO\_REGISTERS routine, LIB-396

LIB\$PUT\_OUTPUT routine, LIB-398  
 LIB\$RADIX\_POINT routine, LIB-400  
 LIB\$REMQHI routine, LIB-402  
 LIB\$REMQHIQ routine, LIB-405  
 LIB\$REMQTI routine, LIB-408  
 LIB\$REMQTIQ routine, LIB-411  
 LIB\$RENAME\_FILE routine, LIB-414  
 LIB\$RESERVE\_EF routine, LIB-423  
 LIB\$RESET\_VM\_ZONE routine, LIB-425  
 LIB\$RESET\_VM\_ZONE\_64 routine, LIB-427  
 LIB\$REVERT routine, LIB-429  
 LIB\$RUN\_PROGRAM routine, LIB-430  
 LIB\$SCANC routine, LIB-432  
 LIB\$SCOPY\_DXDX routine, LIB-434  
 LIB\$SCOPY\_R\_DX routine, LIB-436  
 LIB\$SCOPY\_R\_DX\_64 routine, LIB-438  
 LIB\$SET\_LOGICAL routine, LIB-440  
 LIB\$SET\_SYMBOL routine, LIB-444  
 LIB\$SFREE1\_DD routine, LIB-447  
 LIB\$SFREEN\_DD routine, LIB-448  
 LIB\$SGET1\_DD routine, LIB-450  
 LIB\$SGET1\_DD\_64 routine, LIB-452  
 LIB\$SHOW\_TIMER routine, LIB-454  
 LIB\$SHOW\_VM routine, LIB-458  
 LIB\$SHOW\_VM\_64 routine, LIB-461  
 LIB\$SHOW\_VM\_ZONE routine, LIB-464  
 LIB\$SHOW\_VM\_ZONE\_64 routine, LIB-470  
 LIB\$SIGNAL routine, LIB-476  
 LIB\$SIG\_TO\_RET routine, LIB-480  
 LIB\$SIG\_TO\_STOP routine, LIB-482  
 LIB\$SIM\_TRAP routine, LIB-484  
 LIB\$SKPC routine, LIB-486  
 LIB\$SPANC routine, LIB-488  
 LIB\$SPAWN routine, LIB-492  
 LIB\$STAT\_TIMER routine, LIB-498  
 LIB\$STAT\_VM routine, LIB-502  
 LIB\$STAT\_VM\_64 routine, LIB-504  
 LIB\$STOP routine, LIB-506  
 LIB\$SUBX routine, LIB-508  
 LIB\$SUB\_TIMES routine, LIB-510  
 LIB\$SYS\_ASCTIM routine, LIB-512  
 LIB\$SYS\_FAO routine, LIB-514  
 LIB\$SYS\_FAOL routine, LIB-516  
 LIB\$SYS\_FAOL\_64 routine, LIB-518  
 LIB\$SYS\_GETMSG routine, LIB-520  
 LIB\$TABLEPARSE routine, LIB-523  
 LIB\$TPARSE routine, LIB-523  
 LIB\$TRAVERSE\_TREE routine, LIB-584  
 LIB\$TRAVERSE\_TREE\_64 routine, LIB-586  
 LIB\$TRA\_ASC\_EBC routine, LIB-588  
 LIB\$TRA\_EBC\_ASC routine, LIB-592  
 LIB\$TRIM\_FILESPEC routine, LIB-595  
 LIB\$TRIM\_FULLNAME routine, LIB-598  
 LIB\$VERIFY\_VM\_ZONE routine, LIB-601  
 LIB\$VERIFY\_VM\_ZONE\_64 routine, LIB-602  
 LIB\$WAIT routine, LIB-603

Logical names, LIB-440  
     deleting, LIB-136  
     RTL routines, LIB-136  
 Logical unit number allocator, LIB-271  
 Logical unit numbers, RTL routine to free,  
     LIB-211

## M

Mailboxes, LIB-14  
 MATCHC (Match Characters) instruction, RTL  
     routine to access, LIB-347  
 max\_float boundary value, CVT-13  
 Memory allocation  
     for dynamic length strings, LIB-450 to  
         LIB-452  
     freeing dynamic length strings, LIB-447,  
         LIB-448  
 MOVC3 (Move Character 3 Operand) instruction,  
     RTL routine to access, LIB-352  
 MOVC5 (Move Character 5 Operand) instruction,  
     RTL routine to access, LIB-354  
 Multiplication, LIB-152, LIB-154, LIB-156,  
     LIB-158, LIB-160

## N

NBDS (numeric byte data string), LIB-85  
 Node names  
     See DECnet/OSI full name routines

## O

Octal text, converting to binary, LIB-97, LIB-99  
 Overflow detection, integer, LIB-331

## P

Pause program execution, LIB-384  
 Polynomials  
     evaluating, LIB-385, LIB-387, LIB-390,  
         LIB-392

## Q

Queue information, getting, LIB-233  
 Queues  
     inserting an entry, LIB-317 to LIB-326  
     removing and entry, LIB-402 to LIB-411

## R

Radix point symbol, returning the system's,  
     LIB-400  
 Reserved operands, fix floating-point faults,  
     LIB-199

Run-time library routines  
conversion, 1-8  
CVT\$, 1-8  
library, 1-1  
translated, 1-8

## S

---

SCANC (SCAN Characters) instruction, RTL  
routine to access, LIB-432  
Shareable images, activating, LIB-189  
Sign-extended longword fields, LIB-170  
Spawning a subprocess, LIB-492  
String descriptors, LIB-10, LIB-12  
Strings  
copying by descriptor, LIB-434  
copying by reference, LIB-436 to LIB-438  
dynamic length  
allocating, LIB-450 to LIB-452  
deallocating, LIB-447, LIB-448  
position of substring in, LIB-291

skipping characters in, LIB-489  
Subtraction  
quadword times, LIB-510  
two's complement, LIB-509  
Symbols  
See also CLI symbols  
Systemwide information, getting, LIB-238

## T

---

Time conversion routine, LIB-90  
F\_Floating value, LIB-80  
Translation  
of character sets, LIB-356  
Tree, balanced binary, LIB-299, LIB-308

## V

---

Virtual memory statistics  
returning, LIB-502, LIB-504  
showing, LIB-458, LIB-461

